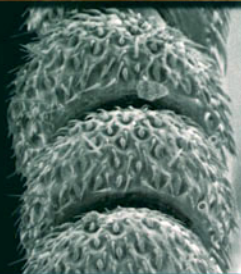


Biology, Ecology & Systematics
of Australian

Scelio

Wasp parasitoids of locust and grasshopper eggs



PAUL DANGERFIELD | ANDREW AUSTIN | GRAEME BAKER

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OF AUSTRALIAN SCelio

Wasp Parasitoids of Locust and Grasshopper Eggs



PAUL C DANGERFIELD
ANDREW D AUSTIN
GRAEME L BAKER

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Front cover

Background: *Scelio bipartitus* Kieffer and distribution map

Photos: *Scelio asperatus* Dodd; *S. setafascis* sp. nov.

Back cover

L. to r.: *Scelio gobar* Walker, anterior head; *S. pilosus* Dodd, lateral mesosoma;

S. gobar Walker, lateral head; *S. gobar* Walker, antennal detail.

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*Dedicated to Alan Parkhurst Dodd
for his pioneering research on the taxonomy of Australian Hymenoptera.*



BIOLOGY, ECOLOGY AND SYSTEMATICS OF AUSTRALIAN *SCELIO*
Wasp Parasitoids of Locust and Grasshopper Eggs

CONTENTS

PAGE

Abstract viii

Acknowledgements ix

Chapter 1 Introduction 1

Chapter 2 Materials and methods 3

 Collecting and rearing 3

 Host egg pods 4

 Estimation of parasitism rates in the field 4

 Laboratory rearing of field collected eggs 5

 External examination of eggs in the field 5

 Field surveys of relative abundance of *Scelio* species 7

 Mass rearing 8

 Study of parasitic development 8

 Studying ovipositional behaviour 8

 Dissections and histology 8

 Histology 9

 Taxonomic illustrations 9

 Scanning electron microscopy 9

 Institutional abbreviations 9

Chapter 3 Biology, ecology and biological control 11

 General biology 12

 Parasitic development (egg, larva, pupa) 12

 Adults 14

 Distribution and abundance 18

 Impact of biotic factors 18

 Impact of abiotic factors on distribution and abundance 26

 Mortality factors 28

 Conservation under pressure from environmental change 29

 Agricultural importance and regional incidence 30

 Natural control of host populations: regional surveys 32

 Potential as biological control agents 35

 Classical biological control 36

 Neo-classical biological control 37

Conservation through modifying insecticide control strategies	38
Augmentation by inundative release	40
Enhancement through environmental manipulation	40
Importance of systematics to ecological studies	42
Chapter 4 Host relationships	43
Hosts of the Scelionini	47
Hosts of <i>Scelio</i> species	47
Erroneous host records for Australian <i>Scelio</i>	49
Host specificity	50
Chapter 5 Morphology	52
General characteristics	52
Head	52
Mesosoma	57
Legs	58
Wings	58
Metasoma	61
Female genitalia and ovipositor system	61
Male genitalia	66
Chapter 6 Phylogeny	67
Morphometric data	67
Phylogenetic methods	67
Selection of taxa	68
Phylogenetic characters	68
Qualitative characters	68
Quantitative or morphometric characters	69
Results and discussion	69
Conclusions	75
Chapter 7 Key to Australian species of <i>Scelio</i>	76
Key to sexes	76
Key to females	76
Key to males	83
Chapter 8 Taxonomy of Australian <i>Scelio</i>	88
<i>Scelio</i> Latreille	88
Diagnosis	88
Relationships	88
Sexual dimorphism	89
Distribution and composition of the Australian fauna	89
Treatment of species	91
<i>Scelio amoenus</i> Dodd	91
<i>Scelio anmarae</i> Dangerfield & Austin sp. nov.	93
<i>Scelio annae</i> Dangerfield & Austin sp. nov.	94

<i>Scelio anyirambo</i> Dangerfield & Austin sp. nov.	96
<i>Scelio asperatus</i> Dodd	98
<i>Scelio australiensis</i> Kieffer	102
<i>Scelio bipartitus</i> Kieffer	102
<i>Scelio borroloolensis</i> Dangerfield & Austin sp. nov.	105
<i>Scelio bronae</i> Dangerfield & Austin sp. nov.	106
<i>Scelio chortoicetes</i> Froggatt	108
<i>Scelio concinnus</i> Dodd	115
<i>Scelio contractus</i> Dodd	117
<i>Scelio cruentatus</i> Dodd	119
<i>Scelio diemenensis</i> Dodd	121
<i>Scelio doddi</i> Dangerfield & Austin sp. nov.	123
<i>Scelio erythropus</i> Dodd	125
<i>Scelio flavicornis</i> Dodd	127
<i>Scelio flavigaster</i> Dangerfield & Austin sp. nov.	129
<i>Scelio fulgidus</i> Crawford	131
<i>Scelio fulvithorax</i> Dodd	135
<i>Scelio gallowayi</i> Dangerfield & Austin sp. nov.	139
<i>Scelio gobar</i> Walker	141
<i>Scelio grbini</i> Dangerfield & Austin sp. nov.	146
<i>Scelio ignobilis</i> Dodd	148
<i>Scelio improcerus</i> Dodd	150
<i>Scelio jokentae</i> Dangerfield & Austin sp. nov.	155
<i>Scelio joni</i> Dangerfield & Austin sp. nov.	157
<i>Scelio littoralis</i> Dodd stat. rev.	158
<i>Scelio locustae</i> Dodd stat. rev.	161
<i>Scelio mannesi</i> Dangerfield & Austin sp. nov.	163
<i>Scelio mareebaensis</i> Dangerfield & Austin sp. nov.	165
<i>Scelio matthewsi</i> Dangerfield & Austin sp. nov.	167
<i>Scelio meridionalis</i> Dangerfield & Austin sp. nov.	169
<i>Scelio miki</i> Dangerfield & Austin sp. nov.	171
<i>Scelio nanocuspis</i> Dangerfield & Austin sp. nov.	173
<i>Scelio naumanni</i> Dangerfield & Austin sp. nov.	175
<i>Scelio nigricornis</i> Dodd	177
<i>Scelio nigricoxa</i> Dodd stat. rev.	179
<i>Scelio nigriscutellum</i> Dodd	181
<i>Scelio nigrobrunneus</i> Dodd	183
<i>Scelio notabilis</i> Dodd	185
<i>Scelio orientalis</i> Dodd	187
<i>Scelio parvicornis</i> Dodd	189
<i>Scelio perspicuus</i> Dodd	192
<i>Scelio petilus</i> Dangerfield & Austin sp. nov.	195
<i>Scelio pigotti</i> Dangerfield & Austin sp. nov.	197
<i>Scelio pilosifrons</i> Dodd	198
<i>Scelio pilosus</i> Dodd, 1913 stat. rev.	201
<i>Scelio planithorax</i> Dodd	204
<i>Scelio pseudaustralis</i> Dangerfield & Austin sp. nov.	206
<i>Scelio punctaticeps</i> Dodd	208

<i>Scelio reticulatum</i> Dangerfield & Austin sp. nov.	210
<i>Scelio schmelio</i> Dangerfield & Austin sp. nov.	212
<i>Scelio semisanguineus</i> Girault, stat. rev.	214
<i>Scelio setafascis</i> Dangerfield & Austin sp. nov.	216
<i>Scelio striatifacies</i> Dodd	219
<i>Scelio sulcaticeps</i> Dodd	221
<i>Scelio tasmaniensis</i> Dangerfield & Austin sp. nov.	223
<i>Scelio unidentis</i> Dangerfield & Austin sp. nov.	225
<i>Scelio varipunctatus</i> Dodd,	227
<i>Scelio zborowskii</i> Dangerfield & Austin sp. nov.	229
Treatment of unassigned males	231
Chapter 9 References	238
Index to scelionid genera and species	253
Index to orthopteran genera and species	254
Index to other genera and species	254

ABSTRACT

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The taxonomy of the parasitic wasp genus *Scelio* L. (Hymenoptera: Scelionidae), which attacks the eggs of locusts and grasshoppers, is revised for the Australian region, and the biology, ecology and host relationships of the genus are reviewed on a worldwide basis. Information is presented on life-history stages, development, mating, oviposition behaviour, fecundity, distribution, abundance, effect on host populations, biological control and host specificity. The genus is rediagnosed and a key to identify both sexes of the Australian species included. Phylogenetic analysis shows that *Scelio* is probably polyphyletic, and can only be rendered monophyletic after the inclusion of *Lepidoscelio* Kieffer and *Sceliocerdo* Muesebeck. Relationships among the Australian species are discussed on the basis of this analysis. Information is presented on the general morphology of the genus, methods and techniques for biological and taxonomic studies, and the distribution and composition of the Australian fauna. The level of sexual dimorphism is discussed, along with its effect on distinguishing between species and interpreting host relationships.

Fifty-nine species are recognised as valid for the Australian fauna; 33 are redescribed and 26 are described as new. The following taxonomic changes are also proposed: *S. australis* Froggatt, *S. froggatti* Crawford and *S. ovi* Girault (previously all synonyms of *S. bipartitus* Kieffer) are synonymised with *S. gohar* Walker; *S. perplexus* Dodd (previously a synonym of *S. flavicornis* Dodd) is synonymised with *S. locustae* Dodd; *S. nigriscutellum pretiosus* Dodd is synonymised with *S. nigriscutellum* Dodd; *S. pilosiceps* Dodd (previously a synonym of *S. flavicornis* Dodd) is synonymised with *S. pilosus* Dodd; *S. semisanguineus nigrocinctus* (previously a synonym of *S. nigricornis* Dodd) is synonymised with *S. semisanguineus* Girault; and *S. varipunctatus claripes* Dodd is synonymised with *S. varipunctatus* Dodd. The holotype of *S. australiensis* Kieffer has not been located and the status of this species remains unclear.

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CHAPTER 1

Introduction

Parasitic wasps of the genus *Scelio* L. are among the most ubiquitous and well-known members of the family Scelionidae. The species are obligate endoparasitoids of the eggs of grasshoppers and locusts (Acrididae) and in many regions, including Australia, they are the only parasitoids associated with acridid eggs. Interestingly, it is this biology that may be the origin of the name 'scelio', which means 'scoundrel' or 'rogue' in Latin. Several species are frequently reared in large numbers from the egg beds of numerous pest species, including *Locusta migratoria* (L.) in the Old World, *Hieroglyphus nigrorepletus* Bolivar, *Patanga succincta* (L.) and *Oxya* species in the Oriental Region, *Melanoplus* spp. in North America, and *Chortoicetes terminifera* (Walker) in Australia. As such, they are important natural enemies, regulating populations of acridids in both agricultural and natural habitats. At least one species, *S. pambertoni* Timberlake, has been employed successfully as a classical biological control agent against *Oxya japonica* (Thunberg) in Hawaii (COPR 1982), reputedly the only successful such program against an acridid. Numerous *Scelio* species are considered important within the overall management of various acridid pests (see Chapter 3).

Recently, an Australian species, *S. parvicornis* Dodd, was considered for the biological control of rangeland grasshoppers (*Melanoplus* species) in North America (Dysart 1992). This proposal sparked a vigorous debate about the advantages and disadvantages of introducing foreign agents against native pests. Considerations of the potential detrimental effects to non-target acridids were used to halt the program (Carruthers & Onsanger 1993; Cunningham 1993; Lockwood 1993a, 1993b; El-Gammal *et al.* 1995; Lockwood & Ewen 1997).

Although for several decades *Scelio* species have featured prominently in biological studies on grasshoppers and locusts, little is known about most members of the genus, including some associated with important pests. Undoubtedly, this is at least partly due to many species inhabiting remote, often semi-arid habitats and having restricted emergence times. However, as models for ecological studies *Scelio* species possess numerous interesting attributes: for instance, most species burrow through soil to get to their host eggs, several species are known to be phoretic, some aestivate, while those that parasitise the eggs of migratory locusts have life cycles closely tuned to those of their mobile hosts.

Scelio is one of the largest genera of scelionid wasps with more than 225 described species. However, this may represent less than 25% of the total world fauna, given that a high proportion of species appear to have restricted distributions, and the faunas of several regions (*viz.* southern Africa, South America and the Indo-Pacific) have been relatively poorly studied. The genus is often collected in large numbers using modern collecting techniques (yellow pan and Malaise traps), and is easy to distinguish because of its incomplete submarginal vein in the hind wing (and usually also the fore wing), flattened uniformly segmented metasoma, and characteristic flexed position of dead specimens. Biological studies on *Scelio* have probably been more extensive in Australia than anywhere else in the world (e.g. Birch 1945; Casimir 1962; Farrow 1981; Baker *et al.* 1985, 1995, 1996). However, despite this interest, no significant work has been undertaken on the taxonomy of the Australian fauna for more than 70 years.

Scelio gobar Walker, described in 1839, was the first member of the genus to be described from Australia. It was one of four species, including *Psilanteris charmus* (Walker), *Triteleia duris* (Walker) and *Idris cteatus* (Walker), which were collected by Charles Darwin at Hobart (Tasmania) and King George Sound (Western Australia) in February and March 1836 on his round-the-world voyage on HMS *Beagle*. These were the first members of the family

Scelionidae recorded from this continent, and more than 60 years transpired before any additional species of *Scelio* were described from Australia. From 1905 to 1915, J.C. Crawford, A.A. Girault, W.W. Froggatt and J.J. Kieffer described eight species between them, but it was the comprehensive work of A.P. Dodd that made the Australian *Scelio* fauna well known and accessible. He published a series of descriptions from 1913, culminating in a detailed revision of the genus, which recognised 29 species (Dodd 1927). Since then, *Scelio* has been virtually ignored taxonomically, except for the generic level synopsis of Australian scelionids by Galloway and Austin (1984).

The primary aim of this study is to revise the Australian *Scelio* fauna in support of ongoing studies on the biology of species associated with grasshopper and locust pests. In so doing we have almost doubled the number of described species, providing detailed morphological descriptions and keys for their identification. Further, a number of taxa were previously incorrectly synonymised, primarily because of difficulties in correctly associating the sexually dimorphic males and females. Several species have been reinstated as valid and, in the case of those removed from synonymy with *S. bipartitus* Kieffer (now known only from males), this has had a significant effect on the interpretation of host relationships involving several important pest acridids, viz. *Austracris guttulosa* (Walker), *Chortoicetes terminifera* (Walker), *Gastrimargus musicus* (F.) and *L. migratoria*. We have also provided a detailed review of the biology, ecology and host relationships of *Scelio* on a world-wide basis and, associated with the taxonomic revision of the Australian fauna, an account of the general morphology of the genus, a preliminary cladistic analysis of relationships among species, and methods and techniques for biological and taxonomic studies.

CHAPTER 2

.....

Materials and Methods

This chapter covers the materials and methods used in the morphological and taxonomic sections of this work, but also reviews methods that are generally used when collecting *Scelio*, and studying their biology and ecology in the field. The discussion of methods employed in the phylogenetic analysis is presented in Chapter 6.

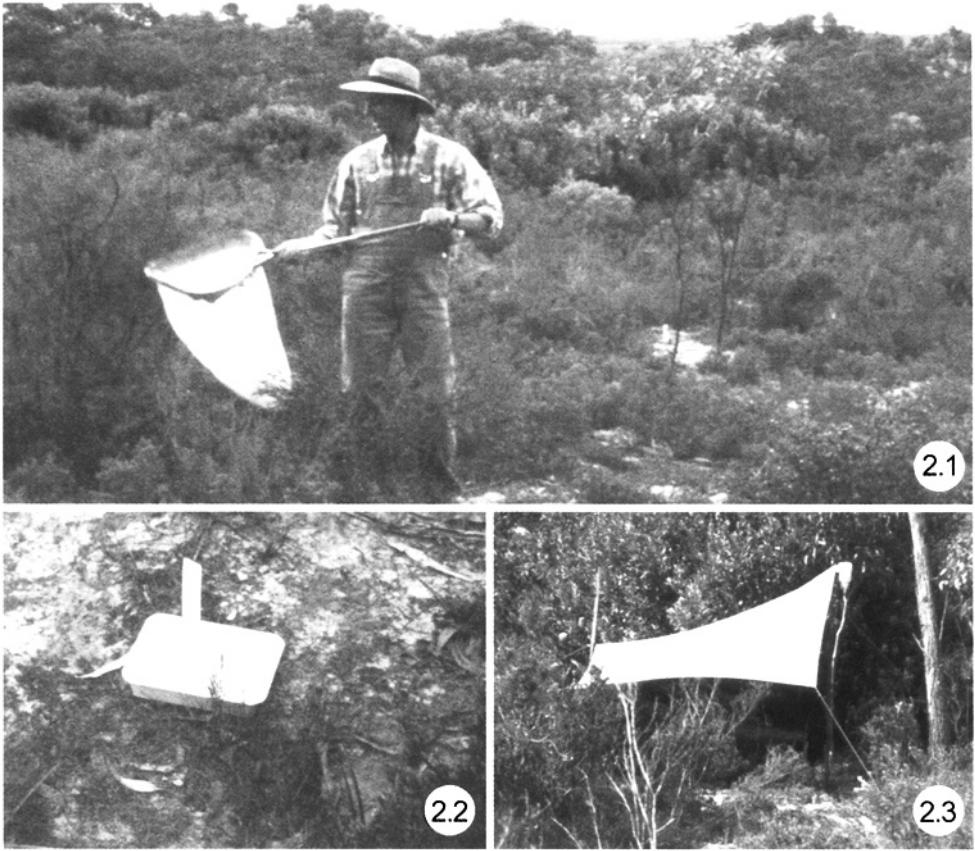
COLLECTING AND REARING

Specimens of adult *Scelio* are easily collected for taxonomic purposes by using the range of standard methods that are employed for most groups of parasitic Hymenoptera. Probably the two most successful collecting techniques are net sweeping in grass and low vegetation and yellow pan traps. Best results with sweeping are obtained using a fine-mesh net with a robust triangular frame (Noyes 1982). The triangular net, in contrast to one with a circular frame, provides a straight edge parallel to the ground, and this optimises the catch of small wasps dislodged from vegetation and knocked into the net (Fig. 2.1). Specimens are then aspirated into a glass vial and killed in alcohol or a freezer.

For many species the emergence of the sexes is not synchronous, with one sex often predominating, depending on the time of sampling. There are also considerable differences in habitat preferences among species. Sites such as bare contour banks, forest edges and roadside table drains often yield higher catches than open grassland, and generally reflect the ovipositional preferences of different hosts.

Yellow pan traps (sometimes called Moericke traps) have been extensively used to collect parasitic Hymenoptera over the last 20 years. They exploit the attractiveness of the colour yellow to several insect groups, including parasitic Hymenoptera. Based on traps originally proposed by Moericke to sample flying aphids (Moericke 1951, 1955; Kirk 1984), they are now widely used to collect scelionid, diapriid and chalcidoid wasps (Masner 1976a; Masner & Huggert 1989; Noyes 1982, 1989). A small waterproof dish or tray painted bright yellow is partly filled with water and a few drops of unscented detergent added to act as a surfactant (Fig. 2.2). *Scelio* and other small Hymenoptera are attracted to or jump into the tray, and sink to the bottom because of the low surface tension caused by the detergent. Plastic microwave dishes (about 20 cm × 20 cm) are ideal as they are lightweight, robust and stack easily into a small volume. Traps can be left in place for long periods, and the contents collected daily with a fine aquarium dip-net. A preservative can be added to the water to prevent rotting of specimens if the traps cannot be cleared on a regular basis. A concentrated salt solution is a cost-effective preservative, or ethylene glycol can be used (Noyes 1982). The latter preservative is highly toxic to vertebrates, and is better used in conjunction with a bittering agent, as in the commercially available form sold as radiator coolant.

Left *in situ*, yellow pan traps can collect very large numbers of scelionids, which appear to be more resistant to rotting than other micro-wasps. This is particularly the case for *Scelio*. Other traps that often yield specimens of *Scelio* are Malaise traps (Fig. 2.3), window traps and flight-interception traps. All of these traps often collect species different from those obtained by sweeping. However, this may have more to do with these traps being left *in situ* for longer periods of time, and therefore being more likely to collect rare species, than it does with differences in flight behaviour among species.



Figs 2.1–2.3. Collecting techniques used to obtain specimens of *Scelio*: **2.1.** Sweeping in open mallee vegetation with a triangular frame net (see text for explanation). **2.2.** Yellow pan trap in mallee vegetation. **2.3.** Malaise trap in mallee vegetation.

HOST EGG PODS

Egg pods of acridid hosts are typically found in the soil to a depth of 1–3 cm. Locating them is not an easy task when the host density is low and is best conducted in areas of known infestation in outbreak years. Oviposition by some host species may be associated with bare soil, e.g. *Aulocara elliotti* (Thomas) (Dysart 1995), or closely associated with the upper roots of specific plants (Dysart 1995). Locust egg beds are best located by observing the oviposition pattern of swarms, by locating basking groups of hatchlings, or backtracking the path of early instar bands.

ESTIMATION OF PARASITISM RATES IN THE FIELD

Rates of parasitism can be determined by rearing from field-collected eggs, by bleaching and examining host eggs in the laboratory, or by external examination of eggs in the field. The most common method used for locust species during outbreaks, when the identity of the parasitoid is known, is examination of eggs in the field. However, laboratory rearing is typically employed for grasshoppers eggs when the parasitic species may be unknown.

LABORATORY REARING OF FIELD COLLECTED EGGS

Eggs pods sampled during the early pre-hatching stage must be retained in individual vials and subsequently reared in the laboratory on clean autoclaved sand (Irshad *et al.* 1978; Dysart 1991) or vermiculite (Hunter & Gregg 1984). A mild fungicide can be added (0.5% Fungizone: Hunter & Gregg 1984). The temperature at which eggs are incubated is dependent on the habitat of the host and may vary from 26-32°C for *Chortoicetes terminifera* (Walker) (Hogan 1965; Hunter & Gregg 1984) to 25°C for *Phaulacridium vittatum* (Sjöstedt) (Baker *et al.* 1995), but 30°C is more universally accepted for acridids in general (Irshad *et al.* 1978; Dysart 1995). Dysart (1995) kept individual pods in 10 dram snap-cap lids buried in a shallow layer of fine white silica sand, which was moistened every two weeks.

Diapause may interrupt the development of some host and parasitoid species, requiring eggs to be subjected to a period of cold treatment prior to incubation at developmental temperatures. The duration of cold treatment is dependent on the intensity of the diapause, but 10°C for 21 days is typically adequate to break diapause (Baker & Pigott 1993). Prolonged incubation at a constant high temperature will eventually break diapause in both host and parasitoid (Wardough 1986), but may be accompanied by mortality at different levels in unparasitised and parasitised host eggs. Birch (1945) incubated *Austroicetes cruciata* (Saussure) eggs parasitised by *S. chortoicetes* Froggatt at 8°C and 13.5°C on alternate days for 18 days after which the eggs were incubated at 30°C; hatching occurred 18.5 days later. However, *S. chortoicetes* failed to emerge from recently laid eggs incubated at a constant 30°C, but did emerge from eggs collected three months after laying and held at constant 30°C for 42 days.

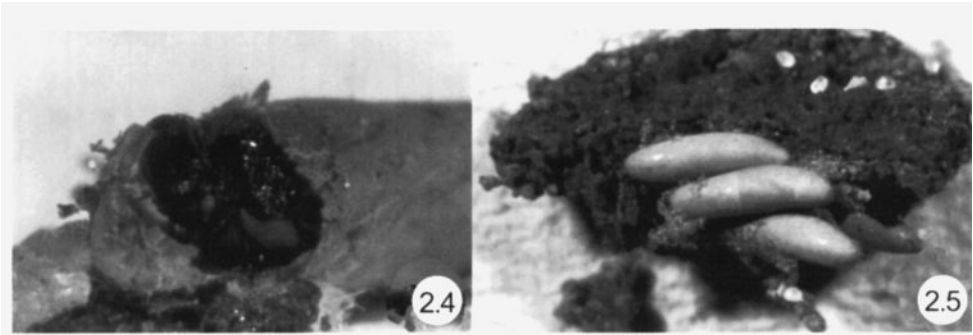
Separation of individual eggs from the pod and their subsequent incubation to hatching is not recommended as it may result in high mortality (Hogan 1965) and therefore over-estimates of host mortality in the field (Baker *et al.* 1996).

EXTERNAL EXAMINATION OF EGGS IN THE FIELD

The method of estimating parasitism varies, depending on the level of accuracy required and time of sampling in relation to hatching of the host. The development time of *Scelio* is greater than that of the host, therefore sampling of parasitised eggs can be undertaken post-hatching of unparasitised eggs. Alternatively, parasitism rate can be assessed after hatching of both host and parasitoid, with determination made on the structure of the remaining egg shells. Empty eggs parasitised by *Scelio* remain intact except for an irregular hole at the anterior end, which has been chewed by the emerging wasp (see Fig. 2.4). Unparasitised eggs from which hoppers have emerged differ in that they are split longitudinally and collapsed. The status of eggs examined post-host hatching, but prior to emergence of adult *Scelio*, can be determined because parasitised eggs contain pharate wasps (Fig. 2.5) and a meconium (excretory sac), while unparasitised eggs are represented by empty pods. Eggs in the late pre-hatching stage also have a white meconium (see Fig. 3.5), thus allowing parasitised eggs to be recognised. During early pre-hatching stages, when there are no external morphological differences between parasitised and unparasitised host, eggs must be returned to the laboratory for either incubation or bleaching.

Crude methods of estimating parasitism post-host hatching include:

- 'Superficial' examination of the soil surface making a distinction between the small holes resulting from *Scelio* emergence (1 mm) and the wide holes (5 mm, often with a 'cap') from which hoppers have emerged. Such a method can apply to cropped areas where soil wash has created a uniform surface (see Fig. 2.6).
- Shallow 'shaving' of the soil surface with a spade and counting the proportion of froth plugs that show a narrow exit hole indicating emergence of *Scelio*, against those where the froth plug has been completely destroyed during the exit of hatchlings. A similar result can be achieved by inverting a section of an encrusted surface (Fig. 2.7).



Figs 2.4, 2.5. Parasitic development of *S. parvicornis* Dodd: 2.4. Adult *S. parvicornis* emerging from a host egg by chewing through the cephalic end of the egg, resulting in a jagged circular opening. This contrasts with the longitudinal split caused by hoppers emerging from unparasitised eggs. 2.5. Pupae inside eggs of *Chortoicetes terminifera* (Walker) showing the distinct tonal variation of the host egg (particularly the middle egg) due to the presence of a white meconium at the host's caudal end, a thin airspace surrounding the parasitoid's head, and thorax with medial dark area that is in close apposition to the abdomen and egg chorion (photos: Dr Richard Dysart).

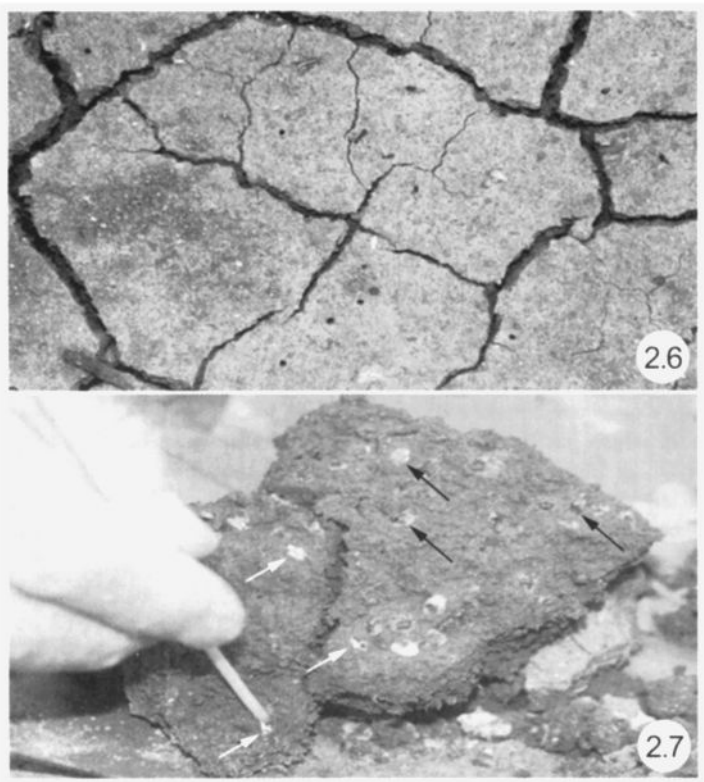


Fig. 2.6, 2.7. Field sampling of parasitised host egg pods: 2.6. Thin soil wash over egg bed showing exit holes and recently emerged adult *S. fulgidus* Crawford from *Chortoicetes terminifera* (Walker) eggs in wheat stubble and weedy headland on an inner country invasion area at Wean, near Gunnedah, NSW, February 1996. 2.7. Inverted crust showing the condition of a froth plug through which both hoppers (large holes, some indicated by black arrows) and *S. fulgidus* adults had emerged (small holes in largely white froth plug, some indicated by white arrows) (photos: Dr Hiroshi Tanaka).

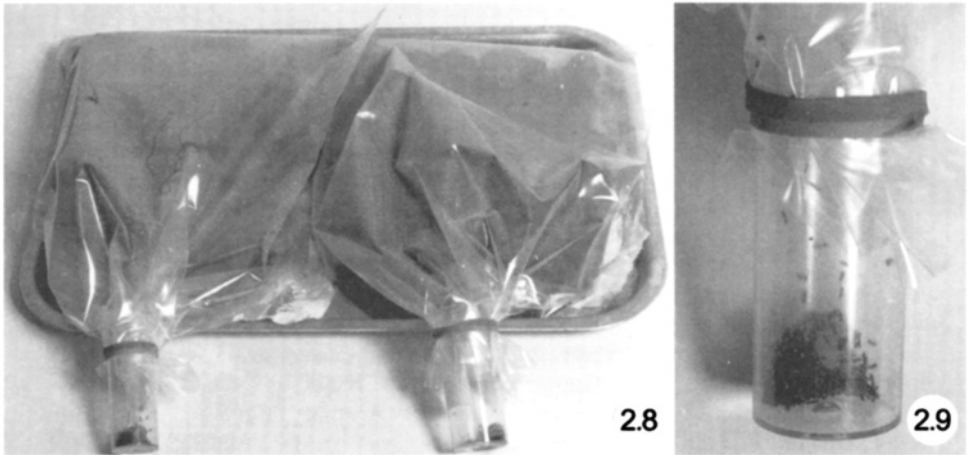
Deep ‘shaving’ and recording pods from which *Scelio* have emerged, indicated by intact eggs with an irregular chewed hole at one end, and eggs from which hoppers have emerged, indicated by the characteristic splitting and collapse of the chorion.

Sampling post-host hatching is usually adopted for locust species, in which oviposition is locally synchronous. This enables easy location of host egg beds, by the presence of basking groups of early instar nymphs, and also easy recognition of parasitised eggs by the presence of a meconium in residual unhatched eggs. Such a method is of use for only determining the proportion of pods parasitised. However, this is perhaps the most useful measure of the impact of parasitism on host populations because unparasitised host eggs are trapped beneath parasitised eggs (Baker *et al.* 1996).

During post host-hatching and late pre-hatching sampling, examination is usually undertaken at known oviposition sites. Parasitism is estimated by ‘clod’ examination where soil is levered out using a spade and is divided by hand into smaller ‘clods’ in which the status of each egg pod is determined. If the clods are of a known area, egg pod density may also be assessed. When grasshopper pods containing few eggs are being sought, a soil sieve may be used during the clod ‘crumbling’ process to catch dislodged egg pods.

FIELD SURVEYS OF RELATIVE ABUNDANCE OF *SCELIO* SPECIES

Intact ‘clods’ of soil taken from egg beds of locusts can be held in plastic bags with a glass vial taped to the open end and the apparatus placed under a dark plastic covering. Emerging wasps are collected into the vial which should contain a cotton wad soaked in sugar-water (Figs 2.8, 2.9). Such sampling provides large numbers of adults, which may be screened to identify and determine the incidence of relatively uncommon species parasitising the host. It may also be used as a source of material for mass rearing (Dysart 1991).



Figs 2.8, 2.9. *Scelio* rearing techniques: **2.8.** Clods of soil from locust egg bed held in plastic bags for emergence of *Scelio* adults (black plastic covering sheet not shown). **2.9.** Close-up of vial with emerged adult *Scelio* (note absence of hoppers due to egg bed being sampled after hatching of unparasitised host eggs; see text for further explanation).

MASS REARING

Mass rearing has been undertaken in connection with field releases of *S. pembertoni* Timberlake in Hawaii and for evaluation of *S. parvicornis* Dodd in a biological control program in Montana (Dysart 1995, 1997). Freshly laid host egg pods are commonly recommended for rearing *Scelio*, however Dysart (1991) found that *S. parvicornis* was attracted to host eggs (*Melanoplus*, *Camnula* spp.) that had been laid in the laboratory and placed at 5°C for up to 12 months. Adult wasps can be fed water and honey solution (Irshad *et al.* 1978). Egg pods are kept moist by providing water at 1–3 day intervals using a pipette (Irshad *et al.* 1978), or every 2 weeks if enclosed in an airtight container. On average, each female *S. parvicornis* attacked 1.6 pods, equivalent to 23 eggs (R.J. Dysart *pers. comm.*)

STUDY OF PARASITIC DEVELOPMENT

The chorion of the host egg can be cleared for observation of the developmental stages of the parasitoid. Eggs can be bleached for 5–10 minutes in 2% sodium hypochlorite solution, which leaves the contents of the egg visible through the transparent vitelline membrane. Eggs so treated remain viable and can be placed on moist blotting paper (Pickford 1964), or moist vermiculite (Hunter & Gregg 1984), and examined under a stereo-microscope as required. Irshad *et al.* (1978) made observations by clearing eggs in xylol for 30 min, after which the egg chorion was removed. For histological sectioning, the developmental stages of *Scelio* can be fixed in Bouin's fluid, stained with Delafield's haematoxylin-eosin and embedded in paraffin (Gerling *et al.* 1976). In order to study parasite development it may be necessary to break diapause first so that development resumes.

STUDYING OVIPOSITIONAL BEHAVIOUR

Field and Austin (1994) were able to observe and record the oviposition behaviour of *Scelio fulgidus* parasitising the eggs of *C. terminifera* by releasing female wasps into large containers in the laboratory. Recently collected, unparasitised egg pods were kept moist and surrounded by a small volume of the soil or clay in which they had been collected. *Scelio fulgidus* adults emerging from other field-collected egg pods were released into the container and, after a short time, burrowed down between the sides of the glass container and soil to oviposit into the eggs. This behaviour was recorded using a video camera attached to a stereo-microscope.

DISSECTIONS AND HISTOLOGY

Internal cuticular structures, particularly the ovipositor system, can be examined to obtain information on functional morphology relevant to taxonomic and phylogenetic studies (Field & Austin 1994; Austin & Field 1997). Both point-mounted (dried) or alcohol-preserved specimens can be used, by clearing them in warm 10% KOH for 1–6 h, which dissolves soft tissues and leaves only sclerotised parts. Cleared specimens should be rinsed in distilled water, covered in a drop of glycerine on a glass slide or an excavated glass block and dissected under a stereo-microscope at high magnification by using fine entomological pins. Semi-transparent structures may best be seen by refracting light from a fibre-optics source through the side of a glass block. Manipulating the light source creates a dark-field effect and reveals fine structures that are otherwise difficult to see. Dissected specimens can then be stored in glycerine-filled genitalia capsules for later examination.

Further information on the internal arrangement of cuticular structures and their relationship with associated musculature can be obtained by slide-mounting specimens after they are washed in distilled water for 5 min, dehydrated through an ethanol series (50, 70, $2 \times 100\%$, 2 min each), and mounted onto slides in Canada Balsam diluted with xylene.

HISTOLOGY

Often more detailed information is required to determine the functional significance of particular morphological structures. This can be facilitated by comparing the results of histological sectioning and scanning electron microscopy for the same structures. In this way Field & Austin (1994) were able to propose a functional model to explain the operation of the ovipositor system of *Scelio*. Their histological examination used freshly killed specimens with the ovipositor system in various stages of extension. Specimens were immersed for 4 h in fixative (3% glutaraldehyde + 3% formaldehyde made up in 0.1 M phosphate buffer, pH 7.4, to which had been added 2.5% polyvinyl pyrrolidone), then washed in 0.1 M phosphate buffer overnight and dehydrated by passing them through an alcohol series. After washing in propylene oxide, they were infiltrated with increasing concentrations of TAAB epoxy embedding resin over 48 h, and then embedded in resin by curing at 60°C for a further 48 h. Glass knives were used in a Sorvall MT2-B Porter-Blum ultramicrotome to cut serial transverse sections of 0.5 mm thickness, starting from the distal end of the ovipositor and proceeding anteriorly. Sections were stained using 0.025% toluidine blue in 0.5% borate buffer.

TAXONOMIC ILLUSTRATIONS

Line drawings were made with a Zeiss DR stereo-microscope using an eye-piece graticule to determine the relative proportions of body parts. Drawings were standardised by orientating specimens so that the frons of the head was vertical to the plane of observation (i.e. so that the interantennal process was just visible), and the dorsal surfaces of the scutum/scutellum and metasoma were horizontal. Drawings were first made onto white bond paper, then traced onto Aarque Clearcraft® drafting film and inked in.

SCANNING ELECTRON MICROSCOPY

Specimens for scanning electron microscopy were cleaned by soaking them overnight in 10% detergent. They were then transferred to an alcohol series, and air-dried on filter paper. Specimens were then mounted on card points with seccotine glue, held on stubs with carbon based plasticine (Lietz-C-Plast) covered with aluminium foil. They were sputter-coated with gold-palladium, and examined under a Phillips XL30 FESEM (field emission scanning electron microscope) recording secondary electron images at 2–10 kV. Images were downloaded from the SEMs hard disc and imported into Adobe Photoshop 4.0 for editing and compiling plates.

INSTITUTIONAL ABBREVIATIONS

Abbreviations used in the text for institutions follow Arnett *et al.* (1997) where possible. The abbreviations marked with an asterisk are not listed in this reference.

AEIC	American Entomological Institute, Gainesville
ANIC	Australian National Insect Collection, Canberra

ASCU	Agricultural Scientific Collections Trust (New South Wales Agriculture), Orange
BMNH	Natural History Museum, London
CNCI	Canadian National Collection, Ottawa
HNHM	Hungarian Natural History Museum, Budapest
MVMA	Museum of Victoria, Melbourne
QDPC	Queensland Department of Primary Industries, Brisbane
QMBA	Queensland Museum, Brisbane
UQBA	Department of Entomology, University of Queensland
USNM	United States National Museum of Natural History, Washington, D.C.
VDAM	Victorian Department of Agriculture Collection, Burnley
WAMP	Western Australian Museum, Perth
WADA*	Western Australian Department of Agriculture, Perth
WINC*	Waite Insect and Nematode Collection, Waite Campus, Adelaide University, Adelaide

CHAPTER 3

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Biology, Ecology and Biological Control

Species of *Scelio* are ubiquitous insect parasitoids of grasshoppers and locusts. For many hosts, including some pest species, they are the only natural enemies of the egg stage. However, there are large continental differences in levels of parasitism recorded and, consequently, in their contribution towards the regulation of host populations. Low levels of parasitism occur in the arid Sahara where plagues of desert locust, *Schistocerca gregaria* (Forskål), originate (Popov 1958; Greathead 1963; Greathead *et al.* 1994), while on the relatively arid continent of Australia, Australian plague locust, *Chortoicetes terminifera* (Walker), is subject to high levels of parasitism in both arid subtropical source areas (Hunter *et al.* 1997) and moist temperate invasions areas (Noble 1938; Hogan 1965; Farrow 1982; Baker *et al.* 1996; Hunter *et al.* 1997). There is a low incidence of *Scelio* in grasshopper eggs in North America (Rees 1973; Dysart 1997) and South America, as exemplified by the absence of records of *Scelio* from the well studied *Sch. cancellata* (Serville) and other pest species (COPR 1982; De Santis & Loiácano 1995). In Europe and Asia there have been insufficient studies to determine the likely effects of *Scelio*, while parasitism has been recorded at high levels in Japan (Muria 1957) and Russia (Rubtsov 1995), but at relatively low levels in India and Pakistan (Irshad *et al.* 1978).

The generally moderate levels of mortality achieved by *Scelio* may reflect a low abundance in well-studied locust species whose numbers are subject to vast fluctuations, while their incidence may be higher in unstudied non-economic hosts whose populations are more stable. Moderate parasitism levels may also reflect the general aridity of regions where locust outbreaks occur. There have been few studies in moist tropical and temperate regions where locust and grasshopper perturbations are less severe. This begs the question as to whether they are unstudied where their effect may be greatest. The erratic impact of *Scelio* on host populations has interested researchers for several decades. Their low incidence in some regions has provided a seemingly vacant niche, while a high incidence in other regions has indicated their promise as biological control agents. In an assessment of the potential role of *Scelio* species in the control of locusts, Siddiqui *et al.* (1986) concluded that, as the only important group of egg parasitoids, *Scelio* automatically warrant study as potential biological control agents. Curiously, many other agents of acridid mortality have received greater attention, e.g. fungi (Milner 1978; Lomer & Prior 1992; Krall *et al.* 1997) and other microbes (Goettel & Johnson 1997), nematodes (Baker & Capinera 1997) and dipteran parasitoids (Greathead 1963).

Scelio have been considered on numerous occasions for inclusion in Integrated Pest Management (IPM) programs (Greathead 1978, 1992; Rees 1985; Siddiqui *et al.* 1986; Dysart 1992, 1997; Austin & Dangerfield 1995; De Santis & Loiácano 1995). *Scelio pembertonii* Timberlake has been utilised successfully for the biological control of *Oxya japonica* (Thunberg) in Hawaii following introduction from Malaysia (COPR 1982). The introduction of exotic *Scelio* species have also been considered for both North America (Dysart 1991) and South America (De Santis & Loiácano 1995).

Their use in biological control programs is hampered by the lack of *in vitro* mass rearing techniques (White 1997) and an inability to predict their potential success under prevailing climatic and biotic conditions. There is also concern over possible disruption of the environment through their effects on non-target host species, and possible competitive displacement of indigenous *Scelio* (Lockwood 1993a; Lockwood *et al.* 2000), both factors mitigating against the introduction of exotic, oligophagous species for inoculative release.

Enhancement of mortality caused by indigenous species through modified locust control campaigns is probably the most pragmatic strategy at the present time.

Scelio species are virtually restricted to parasitising the eggs of Acrididae, with only two species from Pakistan and N.E. Africa known to attack pyrgomorphids as well as acridid hosts (see Chapter 4). The single record from *Scirpophaga incertulas* Walker (Pyralidae) (Chandramohan & Chelliah 1984) is undoubtedly erroneous. Other egg parasitoids of acridids are rare and include *Eurytoma* (Eurytomidae) from Taiwan (Chiu and Chou 1974), *Centrodora* (Aphelinidae) from Taiwan (Chiu & Chou 1974) and Argentina (Liebermann 1951) and, less frequently, *Anastatus* (Eupelmidae) and *Tumidiscapus* (Encyrtidae) (Greathead 1963; Rubtsov 1995). Scelionids recorded from acridid eggs have been listed previously by Uvarov (1928), Greathead (1963) and Siddiqui *et al.* (1986). Complete host–parasitoid checklists for world *Scelio* species are given in Tables 4.1–4.3.

Information on the biology and ecology of *Scelio* is reviewed here on a worldwide basis, not just for Australia. However, much of the research on *Scelio* has been undertaken in Australia and, for this reason, there is an emphasis on Australian species. In this respect, what is known about the biological attributes of the Australian fauna, its host relationships, and impact on host populations, may provide a basis for detailed studies on *Scelio* elsewhere in the world.

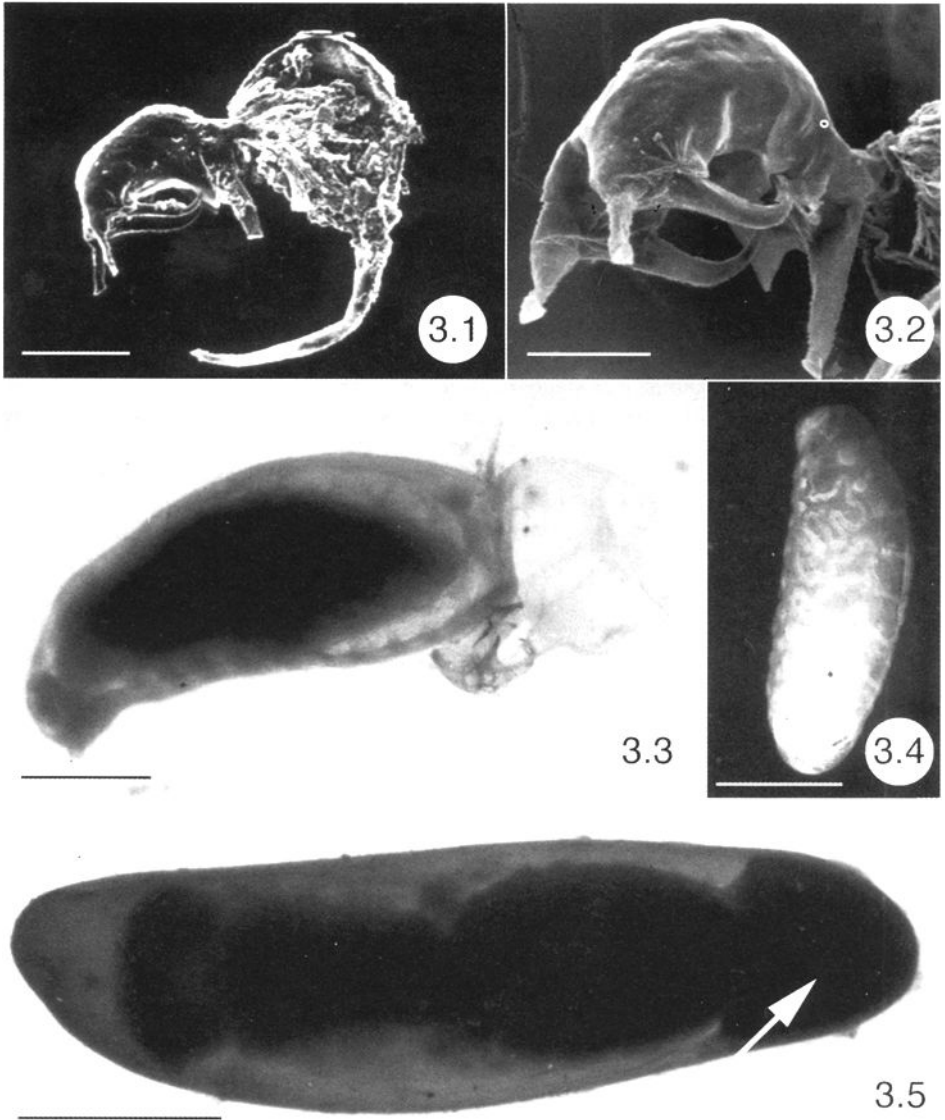
Note: In referring to published studies, an attempt has been made to use the latest accepted species names. For *Scelio* we have used Johnson's (1992) catalogue. However, the taxonomy of some Australian species has changed as a result of the taxonomic research undertaken here (Chapter 8). The most significant effect is on *S. bipartitus* Kieffer, in that virtually all references to this species should now be referred to *S. gobar* Walker (see Chapters 4 and 8). This has been indicated throughout the text as '*S. gobar* (*S. bipartitus* in lit.)'.

GENERAL BIOLOGY

PARASITIC DEVELOPMENT (EGG, LARVA, PUPA)

Female *Scelio* oviposit into acridid eggs, predominantly those located in the soil, and their progeny develop as internal parasitoids. Pupation takes place within the host egg. *Scelio* eggs are like those of many other microhymenoptera: they are stalked with the main body ovate to spindle-shaped and tapering (Rees 1973). They increase in size following absorption of the stalk (Rees 1973). Only one parasitoid develops successfully in each host egg, but several eggs may be laid into each host (Noble 1935). Pickford (1964) found up to 11 eggs of *S. opacus* (Provancher) (= *S. calopteni* Riley) in field-collected eggs of *Melanoplus bivittatus* Say. Egg development is relatively short (<3 days). Irshad *et al.* (1978) give the embryonic development time of several species in Pakistan reared at 31°C as 2–3 days, while Noble (1938) quotes 24 h for *S. fulgidus* Crawford, and Pickford (1964) 7–8 days for *S. opacus* reared at 29°C.

There are two larval instars (Pickford 1964; Irshad *et al.* 1978; Baker & Pigott 1993), although some studies have erroneously reported three (Greathead 1963). The first instar larva is teleaform in that it is constricted into unsegmented cephalothoracic and abdominal regions (Figs 3.1, 3.2). The mandibles are large, curved and sharply pointed (Rees 1973) and are used to kill other *Scelio* larvae in the same host egg or to destroy the host embryo (Pickford 1964). However, Rees (1973) states that the host embryo is not disturbed until the parasitoid is in the second larval instar. There is a large fleshy process on the median ventral line of the cephalothorax below the mandibles, which is considered to be the labrum (Rees 1973). The abdomen is globular with a partial or complete transverse ring of long hairs on the anterior margin, and posteriorly terminates in a tail (Rees 1973). Host eggs become turgid, more opaque and darker than unparasitised eggs (Irshad *et al.* 1978). Moulting to the second instar stage (Fig. 3.3) results in a larva of typical hymenopterous form (Fig. 3.4).



Figs 3.1–3.5. Developmental stages of *S. parvicornis* Dodd: 3.1. First instar larva, whole body. 3.2. Head first instar larva. 3.3. Early stage second instar larva (note ecdysed cuticle of first instar larvae attached to caudal end). 3.4. Late stage second instar larva. 3.5. Pupa with associated meconium (arrowed) inside host egg. Scale lines: 3.1, 20 μ m; 3.2, 10 μ m; 3.3, 50 μ m; 3.4, 100 μ m; 3.5, 1 mm.

Larval development is seasonally variable, with continuous development typically occurring in summer and the intervention of diapause common in overwintering host eggs. Diapause intervening at the first instar larval stage has been reported for *S. opacus* (Pickford 1964), *Scelio* sp. (Richards & Waloff 1954), *S. fulgidus* (Noble 1935), *S. parvicornis* Dodd (Baker & Pigott 1993), *Scelio* sp. A (Irshad *et al.* 1978) and *S. uvarovi* Oglobin (Ji 1985). Diapause is typically facultative and induced by cold conditions, a trigger that has been confirmed for several species: *S. opacus* (Pickford 1964), *S. fulgidus* (Hogan 1965), *S. parvicornis* (Baker &

Pigott 1993) and *S. gobar* (*S. bipartitus* in *lit.*) (Common 1948). In *S. chortoicetes* Froggatt aestivation (i.e. summer diapause) may be obligatory rather than facultative. Birch (1945) found that *S. chortoicetes* parasitising eggs of *Austroicetes cruciata* (Saussure) in late spring (November) aestivated as first instar larvae. Aestivation lasted throughout summer and autumn and was broken by cold conditions in mid-winter, the same conditions that break diapause in host eggs. This is an unusual example of an obligate aestivation intervening under conditions of increasing day length and increasing temperatures. However, emergence of *S. chortoicetes* in spring from overwintering eggs of the alternative host *A. vulgaris* (Sjöstedt) (Baker *et al.* 1985, 1996) indicates *S. chortoicetes* is also capable of a facultative diapause in winter, in addition to the apparent obligate aestivation in *A. cruciata*.

The duration of continuous larval development (i.e. non-diapausing) ranges from 8 to 13 days (Irshad *et al.* 1978) (Table 3.1). Overwintering *S. parvicornis* in host eggs parasitised in late April did not pupate until six months later in October, with adults subsequently emerging in late November (Baker & Pigott 1993). The thermal threshold for development has been assessed only for *S. uvarovi* and is given as 16.3°C with a total development time of 309 day/degrees C (Ji 1985).

The pupa lies in the host egg with its head towards the micropylar end (Fig. 3.5) (Pickford 1964). The pupal stage ranges from 7 to 9 days (Irshad *et al.* 1978) (Table 3.1) for laboratory-reared species in Pakistan, and approximately six weeks in the field in spring for *S. parvicornis* that had overwintered (Baker & Pigott 1993). After pupation, adults emerge from the host egg by chewing an irregular hole (see Fig. 2.4).

Table 3.1. Duration of parasitic development of *Scelio* spp. in laboratory studies

Species	Larva (days)	Pupal (days)	Total (days)	Temperature (°C)	Reference
<i>uvarovi</i>	–	–	21–61	22–30	Ji 1985
<i>fulgidus</i>	–	–	28–54	lab.	M. Davison <i>pers. comm.</i>
<i>aegyptiacus</i>	8	7–8	–	–	Irshad <i>et al.</i> 1978
<i>hieroglyphi</i>	11–13	7–8	18–21	31	Irshad <i>et al.</i> 1978
<i>Scelio</i> sp. A	9–12	8–9	17–21	31	Irshad <i>et al.</i> 1978

ADULTS

Emergence and phenology

The development time of *Scelio* is typically greater than the duration of embryonic development of the host. Adult *S. muraii* Watanabe do not emerge until about a month after the host *O. japonica* has hatched (Miyashita 1963). *Scelio aegyptiacus* Priesner emerged 12 days after hatching of *Aiolopus thalassinus* (F.) (Irshad *et al.* 1978) and *S. opacus* emerged in the field 2–3 weeks after their *Melanoplus* hosts had hatched (Pickford 1964). In the laboratory at 28°C, *S. fulgidus* emerged 5–11 days after emergence of the host *C. terminifera* (M. Davison *pers. comm.*). However, in the field, pharate adults within host eggs and active, newly emerged wasps on egg beds may be found at the same time as third instar locust nymphs, some three weeks after the latter have commenced emerging (Figs 2.5–2.7) (R. Pigott *pers. comm.*). When the uppermost eggs in the host egg pod are parasitised, the delayed emergence of *Scelio* results in emerging host nymphs being trapped and dying below the unemerged parasitised eggs. For host species in which this is a common occurrence, the proportion of pods containing parasitised eggs is a more reliable measure of host mortality than the proportion of parasitised host eggs.

The life-cycle pathways available to *Scelio* can be more varied than those displayed by their host, often resulting in asynchronous development of host and parasitoid (see p. 24).

Peak emergence of adult wasps is usually 2–3 weeks before oviposition by the host, and there is some evidence that males emerge earlier than females. This synchronisation is possibly mediated by adult wasps emerging in response to the same stimuli that initiate oviposition in the host, notably rainfall (D.M. Hunter *pers. comm.*). However, the seemingly poor synchronisation with the hosts for oligophagous *Scelio* is unexplained.

Sex ratio

Scelionids, like the vast majority of parasitic Hymenoptera, display arrhenotokous parthenogenesis, i.e. fertilised eggs produce female offspring and unfertilised eggs produce males. In addition, mated females of many parasitoids are capable of withholding sperm from their eggs, with the result that they can regulate the sex of their offspring. Both of these factors, as well as genetic and seasonal effects, lead to skewed sex ratios, usually in favour of females (Quicke 1997). Also, for egg parasitoids that attack gregarious host clutches, males emerge first and mate with females from the same clutch, often their siblings, and this can lead to local mate competition (see Godfray 1994 for review).

Unfortunately, valid estimates of the sex ratio of *Scelio* are uncommon (Table 3.2), and information available for other scelionids may not be comparable given that they are for very distantly related genera (Austin & Field 1997) parasitising very different host groups with different life histories, viz. Heteroptera and Araneae (e.g. Waage 1982; Austin 1984; Braman & Yeorgan 1989).

Table 3.2. Sex ratio of reared *Scelio*

Species wasps	Number of (male : female)	Sex ratio	Reference
<i>bipartitus</i>	264	1 : 16.5	Dodd 1927
<i>opacus</i>	–	1 : 2.5	Dysart 1995
"	–	1 : 14	Pickford 1964
<i>rufulus</i>	72	1 : 3.7	Dysart 1995
<i>semirufis</i>	365	1 : 0.54	Dysart 1995
<i>striativentris</i>	397	1 : 4.88	Dysart 1995
<i>aegyptiacus</i>	–	1 : 3.8	Irshad <i>et al.</i> 1978
<i>hieroglyphi</i>	–	1 : 4	Irshad <i>et al.</i> 1978

Because the progeny of unmated female *Scelio* are all male (Irshad *et al.* 1978), the sex ratio of populations in the field may relate to the level of mated females in the previous generation. Mating is largely a consequence of abundance so that the sex ratio may also reflect former abundance. Muesebeck (1972, 1979) stated that the preponderance of female specimens in museum collections may be due to biased sex ratios in the field. This may also be a reflection of the collecting method, the habitat collected and the susceptibility to capture. Not surprisingly, there is a discrepancy in the sex ratio between 'on wing' field-collected material and reared material. Baker *et al.* (1995) found that males were 2–5 times more abundant than females in 'on wing' collections, irrespective of the time the samples were taken during the season or the species involved. They concluded that males were more vulnerable to capture because they were searching for females, while females were less accessible as they were presumably restricted to the litter zone. Baker *et al.* (1985) found an earlier predominance of males in spring and autumn and suggested that this indicated a lower temperature development threshold for males than females. Parthenogenic reproduction may account for a predominance of males found in *Scelio* species parasitising *Phaulacridium vittatum* (Sjöstedt). Male biased populations have been observed after a period of localised extinction of greater than three years (Baker *et al.* 1995). The production of males by unmated females increases the chances of mating occurring in the next generation, and consequently may result in an increase in the production of females in subsequent generations.

Sexual maturation, mating and host finding

Very little is known about the reproductive biology of *Scelio*, although a significant amount of information is available for the parasitic Hymenoptera in general and other scelionids (e.g. Gauld & Bolton 1996; Quicke 1997). Females are probably sexually mature when they emerge from the host egg pod (Pickford 1964) as oviposition can commence within 24 h of emergence. Irshad *et al.* (1978) describe the mating behaviour of *S. aegyptiacus* in which the male tapped the female body with his antennae, after which copulation took place, with the male clasping the female and turning the tip of his abdomen under the raised abdomen of the female. Mating in *S. hieroglyphi* Timberlake lasted 1–2 min (Irshad *et al.* 1978). However, it is not known if sib-mating (i.e. between males and females from the same egg pod) occurs, as is common among gregarious parasitoids (Quicke 1997).

Greathead (1992) has indicated that egg size, chorion thickness and habitat determine host specificity in *Scelio*, factors which must all come into operation during host-finding behaviour. Dysart (1995) found no parasitism of *Aulocara ellioti* (Thomas) in the field and concluded that the species of *Scelio* found in rangelands perhaps did not search in the specific habitat in which *A. ellioti* laid eggs. Siddiqui *et al.* (1986) suggest that female wasps dig the soil with their antennae and when a host pod is encountered they chew their way into the froth plug to reach the host eggs.

Oviposition and fecundity

The structure and mechanics of the ovipositor system in *Scelio* and related genera are described in a detailed study by Field and Austin (1994) (see Chapter 5). Although the ovipositor is invaginated entirely into the body, during oviposition it is extended by as much as 3.5 times its length through the telescopic extension of multiple sections of elongated intersegmental membrane, operated by changes in hydrostatic pressure (see Figs 5.24–5.26). The penetration of the egg by the ovipositor leaves a tiny rust-brown mark on the chorion that becomes apparent in dechorionated eggs (Pickford 1964).

Adults wasps have not been observed feeding in the field and it may not be essential for oviposition. However, food in the form of sugar solution has been provided in laboratory cultures (Irshad *et al.* 1978; Dysart 1997). Oviposition commences a few hours after copulation in *S. aegyptiacus* and after 2–3 days in *S. hieroglyphi* (Irshad *et al.* 1978). A preference for freshly laid eggs has been demonstrated for *S. opacus* and *S. javanicus* Roepke (Uvarov 1928; Pickford 1964) and may be universal. This suggests the involvement of a volatile pheromone in the froth plug, giving rise to the relatively high degree of synchronisation apparent between the embryonic development of the host and larval development of the parasitoid (Noble 1938; Birch 1945; Moore 1948; Baker & Pigott 1993). Oviposition has taken place in 96 h old eggs of *S. hieroglyphi* (Irshad *et al.* 1978), but laboratory studies indicate that eggs can be parasitised at later stages (Muria 1959; Dysart 1991, 1992, 1997). Under laboratory conditions, *Scelio* sp. A from Pakistan would not parasitise individual eggs, but did so if egg pods were embedded in soil with a froth-plug (Irshad *et al.* 1978).

Generally the uppermost eggs in a pod are preferentially parasitised and this may be a function of the extent to which the telescopic ovipositor can reach down beside the pod (Field & Austin 1994). However, in those host species in which the egg pod has no wall (e.g. *Gastrimargus musicus* (F.)), and for the hosts of *S. hyalinipennis* Ashmead and *S. oedipodae* Ashmead from North America, oviposition occurs at the base of egg pods (Anon 1962; Morgan 1901, cited in Rees 1973).

Host selection is most likely an obligate sequence of compartmentalised responses to a set of stimuli (Vinson 1976), with perhaps the initial attraction being to ovipositing acridids, then to the froth plug and finally the eggs. There are sufficient examples of oviposition in unnatural hosts, e.g. the Australian species *S. parvicornis* to a range of North American grasshoppers, to suggest that the sequence can be circumvented by wasps reacting as if early criteria had been satisfied when presented with a later stage in the sequence. The broad host

range demonstrated in the laboratory may therefore be an artifact because initial host selection–rejection mechanisms were not invoked. The proportion of host eggs parasitised within a pod is highly variable and appears to be unrelated to the number of eggs available (Basavanna 1953b). There is no general correlation between host ovariole number (maximum number of eggs per pod) and the proportion of eggs parasitised. Host species with a high ovariole number, e.g. *Valanga irregularis* Walker (145–175) (Rajakulendran *et al.* 1993), may have a similar high proportion of eggs parasitised as species with a low ovariole number, e.g. *A. vulgaris* (18) and *P. vittatum* (16) (Table 3.3).

Table 3.3. Relationship between host fecundity and the proportion of eggs parasitised

Host	Fecundity (%)	Parasitism (<i>Scelio</i> spp.)	Reference
<i>Valanga irregularis</i>	145–175	47–80 (<i>S. locustae</i>)	Rajakulendran <i>et al.</i> 1993
<i>Chortoicetes terminifera</i>	30–60	36.7 (<i>S. parvicornis</i>)	R.J. Dysart pers. comm.
		41.9 (<i>S. fulgidus</i>)	"
		32.6 (mixed spp.)	"
<i>Gastrimargus musicus</i>	60–80	–	Common 1948
	32	12.5 (<i>S. gobar</i>)	Baker & Dysart 1992
<i>Melanoplus sanguinipes</i>	30?	35 (<i>S. opacus</i>)	Dysart 1992
		49 (<i>S. parvicornis</i>)	"
<i>Austroicetes vulgaris</i>	18	94.3 (<i>S. chortoicetes</i>)	R.J. Dysart pers. comm.
<i>Phaulacridium vittatum</i>	16	70.5 (<i>S. improcerus</i>)	R.J. Dysart pers. comm.

The fecundity of *Scelio* is highly variable. *Scelio hieroglyphi* parasitised a maximum of 30 host eggs and *S. muraii* 140 eggs (Muria 1959), *S. fulgidus* 234 eggs (Noble 1935), and *S. uwarovi* 80–130 eggs per female (Ji 1985). The number of host eggs parasitised may be greater at higher temperatures, as indicated by *Scelio* sp. A from Pakistan, which averaged 79 eggs at 31°C and 94 eggs at 35°C (Irshad *et al.* 1978).

Longevity

Scelio adults are generally short lived compared with their acridid hosts (Table 3.4), but longevity is variable among individual wasps, possibly because of differing physiological and/or reproductive states. *Scelio opacus* is known to survive for 16 days (range 1–41 days, *n* = 625) at 30°C, while *S. parvicornis* lasted 9 days at the same temperature (range 1–23 days, *n* = 141) (R.J. Dysart *unpubl. data*). Generation time is also relatively short, with that for *S. opacus* and *S. parvicornis* being 30 and 35 days, respectively, at 30°C in the laboratory (R.J. Dysart *unpubl. data*). However, survival times may be much greater at lower temperatures. Also, in regions where the winter is relatively mild, *Scelio* may overwinter quiescently in the adult stage, as has been observed for other scelionids (Austin 1984). This proposal is partly supported by Muesebeck (1972) who collected live *S. striativentris* Kieffer in North America in mid-winter from an old fungus on the side of a dead tree.

Table 3.4. Longevity of adult *Scelio* spp.

Species	Longevity (days)	Conditions (°C)	Reference
<i>aegyptiacus</i>	2	–4	Irshad <i>et al.</i> 1978
	16–22	10	"
<i>hieroglyphi</i>	35	30	"
<i>opacus</i>	16	30	R.J. Dysart <i>pers. comm.</i>
<i>parvicornis</i>	9	30	"
<i>uwarovi</i>	7–14	30	Ji 1985
sp. A	1	–4	"
	1–7	10	Irshad <i>et al.</i> 1978

Phoresy

Phoresy probably occurs less commonly among scelioninid genera than is widely assumed, partly because of the general interest in this behaviour by many biologists (see Clausen 1976). It has been described for *Sceliocerdo viatrix* (Brues) (*Lepidoscelio* in lit.) (Basavanna 1953a) and two species of *Synoditella*, the genus being erected partly on the basis of its phoretic behaviour. *Scelio opacus* is phoretic on three grasshopper species (Rees 1973), while this behaviour has been described in detail for *Syn. bisulcata* (Kieffer) on many hosts (see Table 4.1) (Lanham & Evans 1958, 1960). Despite some instances of phoresy allowing transport with the host, the dispersal abilities of *Scelio* is possibly lower than for other locust and grasshopper parasitoids in that the parasitic stage cannot disperse with the host. However, passive aerial migration under the same synoptic conditions that transport host locusts is likely to carry wasps for substantial distances. For instance, this is probably the case for *S. fulgidus* given the frequent high incidence of wasps in *C. terminifera* invasion areas immediately following immigration, and the absence of any previous local *Scelio* population (Farrow 1981). Phoresy has not been observed for any Australian *Scelio*, nor indicated from records of dead wasps attached to museum specimens of locusts or grasshoppers (D. Rentz pers. comm.).

DISTRIBUTION AND ABUNDANCE

The most important factor influencing distribution and abundance of *Scelio* species is undoubtedly host availability. However, while some studies have revealed the classical deterministic factors driving acridid host abundance (Joern & Gaines 1990), other long-term studies indicate that host abundance may be determined by endogenous factors operating cyclically (Lockwood & Lockwood 1997). The host–parasitoid relationship is itself plastic in that *Scelio* may display host conservation strategies, limiting their own abundance in times of host shortage. Abiotic factors, principally rainfall and temperature, mainly have an indirect influence on parasitoid abundance through their effect on the host, but drought generally has a direct adverse impact on *Scelio* survival. In any consideration of distribution and abundance, not only does the interaction of co-evolved mechanisms need to be considered (such as host range and coincident habitat preferences), but the impact of contemporary factors such as control campaigns, changes in land use, habitat destruction or modification, and climate change.

IMPACT OF BIOTIC FACTORS

As the distribution of many acridid hosts is limited, so too is that of their *Scelio* parasitoids. Distribution is also affected by host range and fluctuations in host distribution, the latter mediated via the advent of favourable seasons and extent and duration of host migrations. Abundance of *Scelio* is influenced by host availability, the suitability of the habitat under prevailing seasonal conditions, the level of persistence of host populations between periods of peak host abundance, and the rate of change and possibly also the direction of change in host abundance. While the absolute abundance of *Scelio* may increase during host outbreaks, the relative impact on host populations may decline and, conversely, during the collapse of a host outbreak, they may have an increasing impact on host populations despite declines in absolute abundance.

Distribution in relation to host range

Although oligophagous species may have a restricted distribution reflecting that of their host, the distribution of polyphagous *Scelio* species is likely to be much broader as it will encompass that of several hosts, particularly if they are allopatric. For example, *S. orientalis*

Dodd is widely distributed in eastern Australia (see Fig. 8.173) and has been recorded only from hosts whose distributions are allopatric (Baker *et al.* 1996). However, some oligophagous *Scelio* may also have a broad distribution, as indicated by *S. gobar* (*S. bipartitus* in lit.) in Australia. This species is found from the tropical lowlands of North Queensland (Girault 1913a) to the tablelands of temperate south-eastern Australia (Baker *et al.* 1995), a distribution sympatric with its principal host *G. musicus*.

In Pakistan, there are several species that have adapted to a wide range of climatic conditions and have wide distributions as a result of polyphagy. *Scelio aegyptiacus* parasitises eight hosts throughout its distribution, which extends from 5 to 1500 m and covers a range in mean annual temperatures of 17–27°C (Irshad *et al.* 1978) (see Table 4.1). Oligophagous species in Pakistan tend to have a limited distribution coinciding with all or part of the distribution of their hosts. Of six species with restricted distributions only two (*S. mauritanicus* Risbec and *S. popovi* Nixon) had more than one host, whereas three polyphagous species (*S. aegyptiacus*, *Scelio* sp. nr. *sergandensis* Timberlake and *S. tristis* (Nixon)) were widely distributed (Irshad *et al.* 1978). The restricted distribution of *S. hieroglyphi* in Pakistan is attributed to its preference for the equally restricted host *Hieroglyphus banian* (F.) (Irshad *et al.* 1978).

Distribution in relation to habitat

The habitat preferences of *Scelio* species are typically correlated with the habitat preferences of their hosts. However, adaptation by a host to recent land-use changes may result in a distribution far wider than that of its *Scelio* parasitoid, and this may contribute to the recently developed pest status of some acridids. Current agro-ecosystems also lack the diverse vegetation which generally favours higher rates of parasitism (Russell 1989).

Irshad *et al.* (1978) found *S. aegyptiacus* parasitism was greater on artificial embankments within a field than in the field itself (1% vs 3–19%). Further, it varied consistently on the embankment, being low on the bare crest relative to the vegetated sides of the embankment (3% vs 11–19%). These authors also suggest that *Scelio* adults are more frequently encountered in moist timbered habitats, which probably provide shelter from excessive heat.

In Australia, the apparent site affinity displayed by *S. parvicornis* is a reflection of the former distribution of the host *P. vittatum*, and is anachronistic given the contemporary ecology of the host, which is now widely distributed in improved, clover rich, pastures (Baker *et al.* 1995). Within grasslands, many species such as *S. gobar* (*S. bipartitus* in lit.), *S. fulgidus*, *S. opacus* and *S. javanicus* are apparently sympatric yet remain oligophagous, possibly due to different micro-habitat preferences by their respective acridid hosts. Micro-habitat preferences will certainly become more apparent when the reasons for the highly variable parasitism levels within grasslands are elucidated.

Abundance in relation to host density

Scelio species appear to be inversely dependent on host density, in that several studies have reported an increased incidence of *Scelio* in declining host populations. Farrow (1982) reported *S. fulgidus* was far more abundant in both proportional and absolute terms following decline in abundance of *C. terminifera*. Parasitism rates are typically low in the first generation following an influx in which host densities are often exceedingly high (Figs 3.6, 3.7). Bomar *et al.* (1993) found parasitism of rangeland grasshoppers by *S. opacus* was significantly greater in plots treated with *Nosema locustae* Canning, where a 50% reduction in host populations had occurred compared with untreated plots. Elevated parasitism by *S. parvicornis* was associated with a mermithid nematode-induced decline in host abundance in the southern tablelands of New South Wales (Baker *et al.* 1995).



Fig. 3.6. Egg beds with ovipositing *Chortoicetes terminifera* (Walker) in the Moree district, April 1979 being examined by the late Mr Jack Kleinhans for *S. fulgidus* Crawford.

Mahmood and Qazi (1989), in a study of regional differences in acridid egg pods in Pakistan, found the highest parasitism by *Scelio* in districts with the lowest grasshopper egg pod density. They found a positive relationship between relative abundance of hosts and the proportion of parasitoids reared, indicating little difference in host species susceptibility to parasitism. There was one notable exception, *Spathosternum prasiniferum* (Walker), which composed only 10% of the grasshopper egg pods but had a parasitism rate of 35%, indicating relatively high susceptibility to parasitism relative to its abundance.

Mukerji (1987) found a second order inverse density dependence between the rate of change in the adult density of *Melanoplus* populations and parasitism of egg pods by *S. opacus*, i.e. higher rates of parasitism were associated with lower rates of population change. There was no relationship between parasitism and the density of adult grasshopper hosts.

There have been no studies on the relationship between host density and parasitism under conditions of increasing host density, but a negative relationship is generally assumed because of a perceived greater reproductive capacity of the host. However, low parasitism in the recessionary phase of the host outbreak cycle due to low host abundance and adverse climatic conditions could result in an increase in the abundance of *Scelio* during the outbreak development phase (Farrow & Baker 1993).

Abundance in relation to host generation

In studies undertaken during host outbreaks, the level of parasitism by *Scelio* generally increases between consecutive host generations. Typically such studies commence at peak outbreaks, corresponding with local gregariousness or the immigration of locusts into a district, and so are representative of only one phase of the locust outbreak cycle. Baker and Dysart (1992) reported an eightfold increase (from 4–11 to 62–88%) in parasitism between two consecutive generations of *G. musicus* in New South Wales. There was also a 57% decline in the density of host egg pods over the same period, which they suggested was an indication of inverse host density dependence. Clark (1972) recorded a fourfold increase in *Scelio* parasitism between the autumn and summer generations of *C. terminifera* in central-western New South Wales in 1969 (from 10 to 36%) and noted this was associated with a relatively spatially static declining host population.

Parasitism of *C. terminifera* in invasion areas varies little between first and second generations when the initial invasion occurs in summer, but increases substantially when it occurs in autumn (Hunter *et al.* 1997). Parasitism levels in the arid source areas do not vary as greatly between host generations as in invasion areas, and this may be due to the generally greater continuity in the availability of hosts (D.M. Hunter *pers. comm.*). Given the greater diversity of habitats in invasion areas, more efficient parasitism might have been expected (Russell 1989). However, this may not apply in this instance because *C. terminifera* populations are ephemeral in the invasion areas of south-eastern Australia. In arable invasion areas, there is a decline in parasitism between the summer and autumn generations when invasion occurs in summer (Figs 3.7, 3.8). The seasonal generation would appear to be more important than the outbreak generation, because during the course of an outbreak parasitism rate may rise (through autumn, spring and summer) and fall (through summer and autumn, Fig. 3.8). Few outbreaks persist long enough in one district to compare the same generation in consecutive seasons. However, during the two outbreaks where this had been possible to observe (autumn and spring 1976–77 and 1991–92, Fig. 3.8) there was a decline between the autumn generations on both occasions. This indicates a generational increase in abundance throughout a season, but a decline in autumn to start afresh in the next season. The cause is unknown, but the adverse effects of mid-summer drought on the survival of parasitised eggs and the desynchronisation of host and parasitoid populations towards the end of the season are suspected. In Papua New Guinea, *Scelio* sp. (nr. *S. javanicus*) also exhibited a seasonal fluctuation in parasitism of *L. m. migratorioides* (Reiche & Fairmaire), being abundant at the end of the wet season (April–May) and declining during the dry (Baker 1975; Young *et al.* 1982).

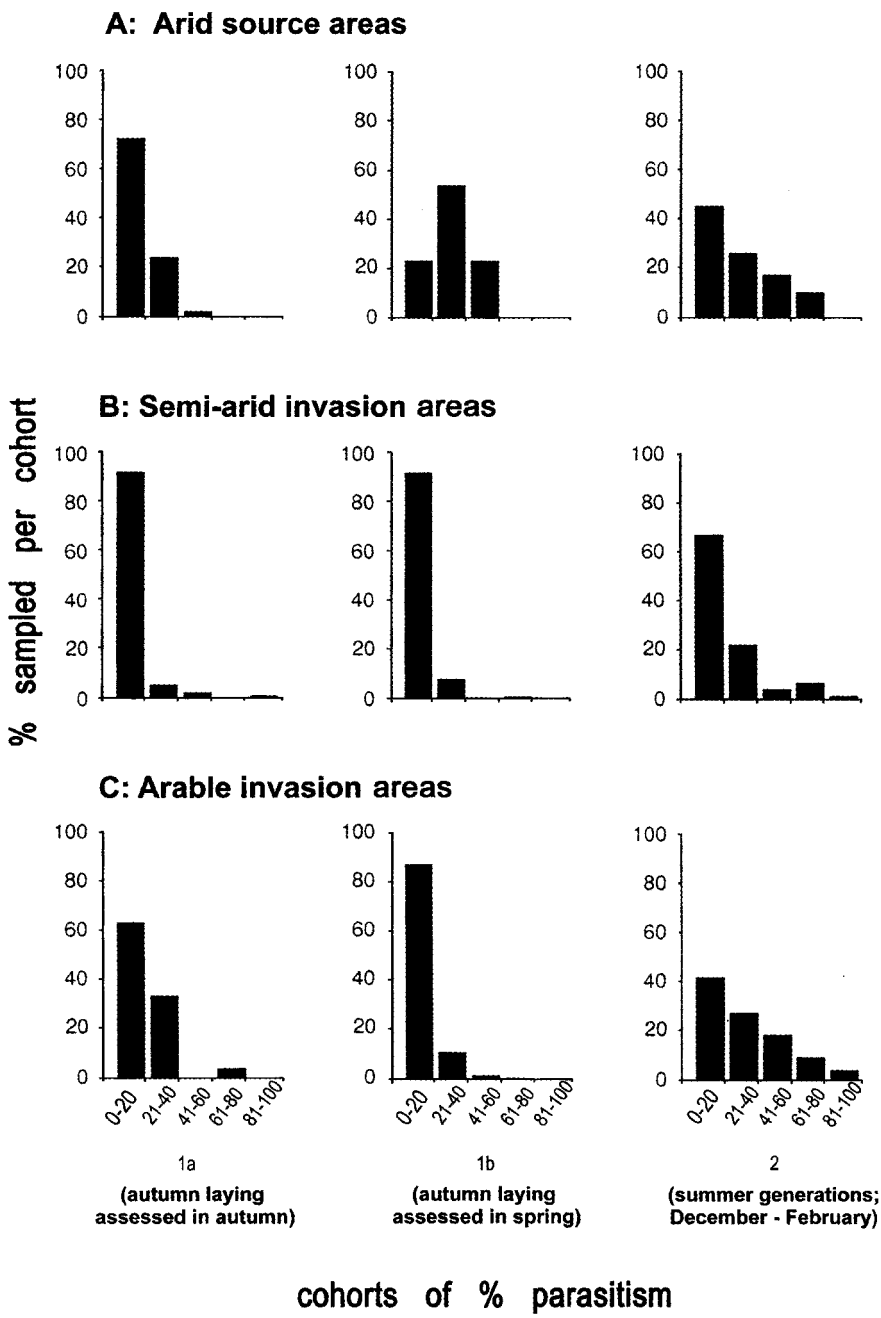


Fig. 3.7. Parasitism of eggs of *Chortoicetes terminifera* (Walker) by *Scelio fulgidus* Crawford in relation to region and host generation within the season. The regions compared are (A) arid source areas, (B) semi-arid invasion areas, and (C) arable invasion areas. The generations compared are (1a) autumn laying assessed in autumn, (1b) autumn laying assessed in spring, and (2) summer generations (December–February). Parasitism is expressed as the percentage of samples which falls into cohorts of 20% (0–20 to 80–100) (from Hunter *et al.* 1997). Note substantial increase in parasitism in arid areas between the autumn and spring assessment due to large overwintering component.

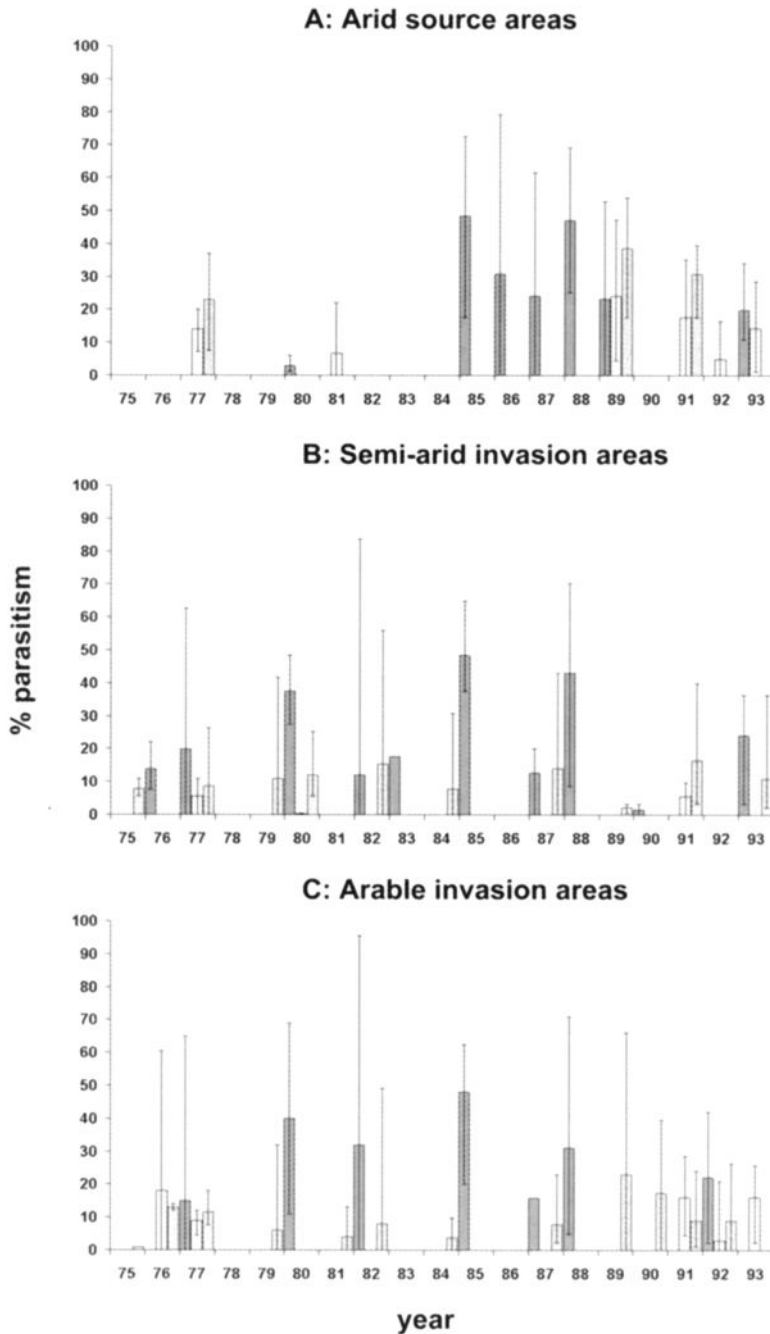


Fig. 3.8. Temporal changes in parasitism of *Chortoicetes terminifera* (Walker) by *Scelio fulgidus* Crawford in relation to region, year (season), and host generation for the period 1975–1993. (Bars, means; lines, ranges; open columns, late summer generation in arid source areas and autumn generation in invasion areas (assessed in autumn); stippled columns, autumn generation assessed in spring in invasion areas and spring generation in arid source areas; solid columns, mid summer generation (all regions) (from Hunter *et al.* 1997).

Exceptions to a generational increase have been recorded. Chiu and Chou (1974) working in Taiwanese rice fields found a decline in parasitism of *Oxya hyla* Serville by *S. oxyea* Timberlake from 2.6 to 1.7% between the first and second rice crops. A more substantial decline was recorded for the egg parasitoid *Centrodora speciosissima* (Girault) (from 28 to 0.01%), where other factors such as seasonal conditions and/or insecticide usage may have played a role.

Abundance in relation to outbreak stage

The abundance of *Scelio* is generally greatest as a host outbreak declines into recession, although few researchers would suggest a causal relationship. Abundance is generally low during the recessionary phase between outbreaks although, again, few would suggest that their low abundance is responsible for the recovery of the host population. There are no studies of sequential changes during a single outbreak as research is usually initiated on peak outbreaks then ceases when host egg-pod density is low.

During the well-studied phase of outbreak decline, most authors report increasing levels of parasitism. Clark *et al.* (1969) indicated that parasitism is relatively important against outbreak populations as they decline, but suggested that the role of parasitoids against solitary populations is inconsequential because the high incidence in declining outbreak populations is the result of an increase in absolute abundance during the outbreak. Conversely, Greathead (1992) concluded that there is much lower parasitism of the gregarious phase of locusts than the preceding solitary phase, unless the gregarious populations remain static. This implies that the migration of the gregarious phase keeps parasitism low or that *Scelio* display inverse host density dependence in the outbreak development phase. Given that the remarks of Clark and Greathead apply to different phases of the outbreak cycle, their conclusions are not necessarily contradictory.

Irshad *et al.* (1978) state that the efficiency of *Scelio* is adversely affected by the often patchy distribution of their hosts, and suggest that they may be more effective where there is a continuous distribution of hosts over large areas, particularly during host outbreaks. It has also been suggested that the conditions which cause host population collapse, notably emigration and low survival under drought conditions, have little impact on *Scelio* species which do not emigrate (except under specific synoptic conditions; Farrow 1981), and which, as pharate adults, are relatively unaffected by dry conditions. Consequently residual host populations may be subject to high parasitism.

Abundance in relation to synchronisation with host phenology

Frequently, both the host and associated *Scelio* parasitoid exhibit developmental pathway plasticity with rapid and continuous development in summer and slow development, often with the intervention of diapause, in winter. Although both host and parasitoid may co-exhibit a variety of pathways, their utilisation may be disproportionate. Generally the greater the host population density the broader the temporal base (seasonal occurrence/generation time) and the more heterogeneous are the developmental pathways. In *C. terminifera*, high abundance is the result of frequent high rainfall that results in overlapping generations, and increasing temporal availability of ovipositing hosts (D.M. Hunter *pers. comm.*) and this will favour the persistence of *Scelio*. Low host abundance narrows the temporal base and restricts the number of developmental pathways that operate. The level of synchronisation between the developmental pathways of the host and parasitoid is therefore, in part, a consequence of relative densities. Unsynchronised development, coincident with low host abundance, operates to the detriment of the parasitoid population and can be viewed as a 'host conservation strategy' (Fig. 3.9). Synchronisation may on occasions be achieved by switching between alternate hosts with each generation, or by utilising immigrant host populations, as occurs in *S. parvicornis* (Baker *et al.* 1996). Polyphagy in species such as *S. parvicornis* may have arisen as a consequence of poor synchronisation with a single host.

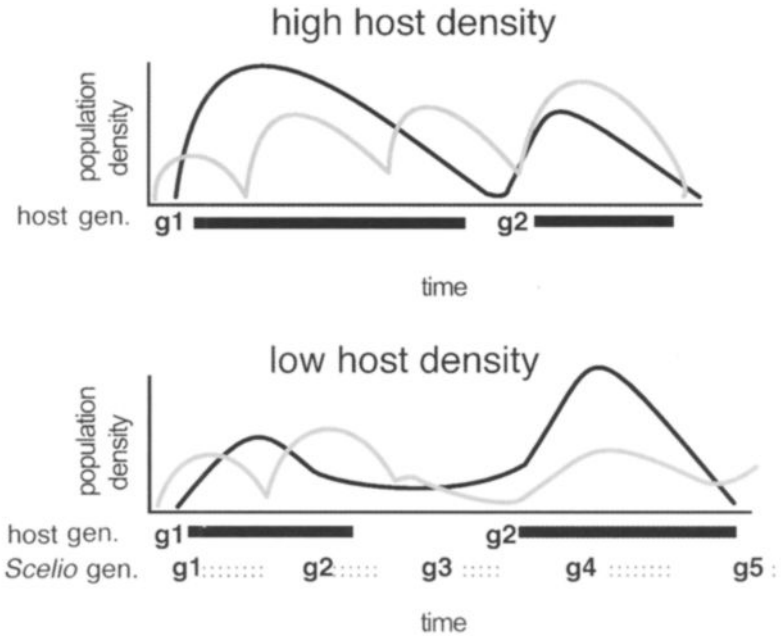


Fig. 3.9. Schematic representation of the effect of synchronisation of host and *Scelio* developmental pathways. Note high density host populations persisted for a longer period than low density populations, the protracted host generation being further parasitised by adults which arose from non-diapause larvae in early laying by the same host generation. This second episode of parasitism increases substantially the capability of *Scelio* to overwinter.

In North America, high levels of phoresy in July (60–70% of female hosts) by *Syn. bisulcata* on *Melanoplus confusus* (Scudder), an early hatching grasshopper, is attributed to an absence of alternative hosts at the time overwintering wasps emerge (Lannham & Evans 1960). When a second parasitoid generation arises later in the season (September), several alternative acridid hosts are abundant and the level of phoresy is low (approximately 10%), but absolute numbers are possibly 5–10 times higher than in July (Lanham & Evans 1960). This seeming dependence on a single host species early in the season could be seen as a risky strategy, and further indicates the important role host diversity may play in maintaining *Scelio* diversity.

In Australia, the level of synchronisation may be both geographically and seasonally variable between *S. gobar* (*S. bipartitus* in lit.) and the host *G. musicus*. In subtropical Queensland *G. musicus* has two generations, with eggs being laid mid-summer and in autumn, when a partial hatch producing overwintering nymphs may occur (Common 1948). In temperate eastern New South Wales, *G. musicus* has a single generation with all eggs laid in autumn overwintering. In Queensland, *S. gobar* exhibits exclusively continuous development in both summer and autumn generations, where overwintering wasps are able to parasitise eggs laid early in the season by hosts that had overwintered as nymphs (Mungomery 1944; Common 1948). In New South Wales, *S. gobar* overwinters as larvae in host eggs, although anachronistic overwintering as pharate adults has been recorded (Baker & Dysart 1992). This latter developmental pathway confers no adaptive advantage in temperate regions where there is no overwintering nymphal population to fledge early in spring. Although the overwintering of eggs of *G. musicus* is the major developmental pathway, the absence of a similar overwintering pathway in *S. gobar* (Common 1948) is an example of poor synchronisation of developmental pathways. *Gastrimargus musicus* also

occurs in tropical regions of northern Australia, Papua New Guinea and the Solomon Islands (COPR 1982) where greater synchronisation between host and parasitoid may occur, the temperate and subtropical distribution being perhaps of recent (Pleistocene) origin.

In Pakistan, *S. hieroglyphi* parasitises the eggs of *H. banyan*, which are laid in September. However, this parasitoid emerges from the overwintering eggs of *Hieroglyphus* species in June–July, two months earlier. Irshad *et al.* (1978) postulate that *S. hieroglyphi* must have passed through a generation in an unknown alternative host in the interval between the overwintering and September generations.

IMPACT OF ABIOTIC FACTORS ON DISTRIBUTION AND ABUNDANCE

Abiotic factors impact on *Scelio* populations indirectly through their effect on host abundance, and directly through their effect on development and survival of the parasitoid. Rainfall is considered the most important abiotic factor affecting host abundance through its influence on food availability (Joern & Gaines 1990). Generally, there is a positive relationship between rainfall and host abundance (Hunter 1996), and with *Scelio* abundance through its effect on wasp emergence and larval survival. The detrimental impact of drought on parasitoids is a possible cause of host population resurgence following the return to favourable conditions (Casimir 1962). Temperature affects the rate of development, including the induction of diapause and, therefore, influences the level of synchronisation and efficiency of the parasitoid.

Effect of dry conditions on survival

There is a discrepancy between the moisture requirements of host eggs and *Scelio*, frequently resulting in differential survival under marginal rainfall conditions. Dry conditions are more detrimental to the survival of eggs parasitised by *Scelio* than of unparasitised host eggs. Baker (1978) found that dry conditions in the northern tablelands of New South Wales in late spring, 1977 did not affect the viability of *G. musicus* eggs but adversely affected the survival of *S. gobar* (*S. bipartitus* in *lit.*). Also in Australia, a large *C. terminifera* egg bed in the Deniliquin district of New South Wales in November 1979 straddled a flood-irrigated forage sorghum crop and an unirrigated native pasture. Parasitism by *S. fulgidus* and desiccation were inversely related in the two sectors of the egg bed, showing a possible differential survival of *S. fulgidus*.

Chortoicetes terminifera generally exhibits a low incidence of parasitism in semi-arid regions (Clark *et al.* 1969; Baker & Pigott *unpubl. data*). However, Hunter *et al.* (1997) found that parasitism rates in arid source areas were comparable to those in arable invasion areas for the same seasonal host generation, during host outbreaks, and following high rainfall (Figs 3.7, 3.8). The unexpectedly high levels of parasitism in arid source areas may be due to a higher level of co-adaptation in what is the natural permanent habitat of *C. terminifera*, compared with that in the ephemerally (erratically) occupied invasion areas (D.M. Hunter *pers. comm.*). However, in source areas the protracted favourable rainfall that leads to host outbreaks might also be expected to favour *Scelio*. Whereas in invasion areas, the endemic base population of *Scelio* will have experienced a wide range of conditions, both favourable and adverse, prior to the influx of hosts.

A high incidence of parasitism of *C. terminifera* by *S. fulgidus* (14–55%) reported by Clark (1972) in the summer of 1969 in the central-western plains of New South Wales was associated with dry conditions. 'In this case, egg laying by the host occurred in late November and December and yet 'no effective rain fell after early November before the swarms began to oviposit'. Therefore, dry conditions did not appear to have any detrimental impact on the incidence of *Scelio*. However, a greater resistance to desiccation in parasitised eggs than unparasitised eggs has been demonstrated for some species, but this may be restricted to

eggs in which the parasitoid is aestivating. Birch (1945) found that eggs of *A. cruciata* parasitised by *S. chortoicetes* were more resistant to desiccation than unparasitised eggs. This was attributed to the fact that by killing the host embryo, the parasitised egg remained at a desiccation resistant stage, while unparasitised eggs developed to stages where they were more vulnerable to desiccation.

Effect of wet conditions on abundance

Although there is usually a positive relationship between rainfall and *Scelio* abundance (see above), for univoltine species the response may be delayed until the next season, with adult abundance being relatively independent of the conditions in that season. The mechanisms by which rainfall influences *Scelio* abundance are possibly through higher survival of developing parasitoids, more successful emergence of wasps from egg pods, greater survival of free-living adults, and synchronisation of emergence with oviposition by the host. The generally greater abundance of hosts under wet conditions may also favour a greater abundance of *Scelio*.

Rainfall stimulates both the emergence of pharate *S. fulgidus* (Noble 1935; D.M. Hunter *pers. comm.*) and oviposition by its host *C. terminifera* (Clark 1972), ensuring a high level of synchronisation of these events in areas of low, erratic rainfall. In regions with consistently high rainfall, as is found in subcoastal invasion areas, there is a greater chance for asynchronous *Scelio* emergence and host oviposition. This may account for the unexpectedly low parasitism in 'softer' environments. During sampling for adult *Scelio* associated with *P. vittatum* over a six year period, Baker *et al.* (1995) found a generally low abundance or absence of wasps. High numbers were recorded only in one season (1993–94) that had low rainfall, but which was preceded by two seasons of high rainfall. Wasp abundance then declined sharply again in the year following the season of below-average rainfall.

The effect of rainfall on parasitism is best demonstrated in multivoltine species whose generations alternate between wet and dry conditions, as in the monsoonal tropics. During an outbreak of *L. migratoria* in Papua New Guinea between 1974 and 1978, *Scelio* sp. (nr. *S. javanicus*) parasitised <30% of eggs at the end of the wet season (April 1974). The parasitoid was virtually absent during the dry season, and then returned at moderate levels (>10%) at the onset of the wet season in December 1974 (Anon 1974; Baker 1975). However, parasitoids were not considered to be important in the population dynamics of this locust as low productivity and survival of the egg stage during the dry season were thought to be the key factors in causing the collapse of the outbreak (Young *et al.* 1982). Drought is also considered to have initiated this outbreak (Baker 1975) and the 1996–97 outbreak in neighbouring Indonesia (Lecoq & Sukirno 1999). Two mechanisms are suggested: the suppression of parasitoids including *Scelio* and mermithid nematodes (Baker 1975; Baker & Capinera 1997), and the concentration of populations in restricted habitats inducing gregariousness (Baker 1993; Lecoq & Sukirno 1999).

Moisture has also been shown to be a critical factor in the ecology of other species of *Scelio*. Mukerji (1987) found that moisture plays a key role in the emergence of adult *S. opacus* in that a highly significant relationship exists between 'wetness' and parasitism in August. This is the month in which overwintering parasitoids emerge and the hosts *M. bivittatus* and *M. sanguinipes* (F.) are at peak oviposition (oviposition takes place from July to September). Hogan (1965) reported a high level of mortality in overwintering *C. terminifera* eggs during the winter (June–August, 1955) (mean 39.1%) and attributed this to prolonged waterlogging of the soil under conditions of above-average rainfall. The samples in which total egg mortality was high generally suffered low parasitism (Fig. 3.10) and it was concluded that eggs parasitised by *S. fulgidus* were more susceptible to waterlogging than unparasitised eggs.

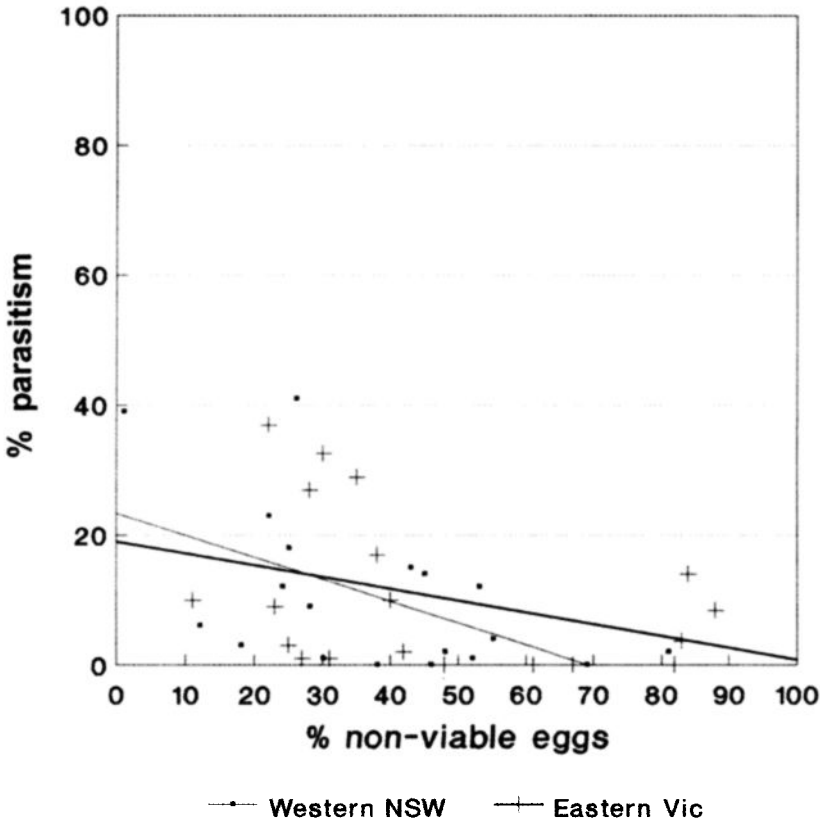


Fig. 3.10. Relationship between parasitism of eggs of *Chortoicetes terminifera* (Walker) and mortality from unknown factors (after Hogan 1965).

Effect of temperature on abundance

Given that there is an upper and lower temperature development threshold and that this varies among species, a wide variation in temperature effects may be expected. In the field Mukerji (1987) found that heat in August was negatively correlated with parasitism of *Melanoplus* species by *S. opacus*. This was in keeping with a positive relationship between ‘wetness’ (a ratio of cumulative rainfall and potential evapo-transpiration) and parasitism. Irshad *et al.* (1978) found *Scelio* sp. A was more fecund at higher temperatures and that, although oviposition took place at 20°C, immature stages did not develop. Likewise, Putnam (1953) suggested parasitism was higher in regions of Canada with relatively warm local climates.

MORTALITY FACTORS

Complimentary biotic and abiotic mortality factors

Irshad *et al.* (1978) provided data on the relative incidence of host egg mortality in fully and partially parasitised pods. When presented graphically (Fig. 3.11) their data show that mortality was always greater in those pods that were fully parasitised (1.4–17.6 times greater), indicating that parasitised eggs are more vulnerable, or exhibit a greater susceptibility to unknown mortality factors. Irshad *et al.* (1978) suggested that this mortality could be due to

probing by *Scelio*, the drying of eggs or fungal attack. The parasitism data of Hogan (1965) (Fig. 3.10) shows an inverse relationship between the level of parasitism by *S. fulgidus* and mortality from other causes, mainly considered to be waterlogging. Baker *et al.* (*unpubl. data*) found a negative relationship between parasitism by *S. fulgidus* and desiccation in *C. terminifera* egg beds, i.e. parasitism was high in egg beds with low levels of desiccation. This was interpreted as *C. terminifera* egg pods parasitised by *S. fulgidus* being more vulnerable to desiccation than unparasitised eggs. Further, an eggbed in the Riverina (Baker & Pigott *unpubl. data*), which extended from an irrigated sorghum crop into a native pasture, had 28% parasitism in the sorghum and only 1.7% in the native pasture, whereas desiccation was zero in the sorghum and 32% in the pasture. While the difference in desiccation levels is readily explained, the low parasitism in the undesiccated egg pods in the native pasture is attributed to a greater susceptibility to desiccation of parasitised eggs. However, *S. fulgidus* could also have had a preference for searching in the irrigated site because of higher humidity or lower soil surface temperatures.

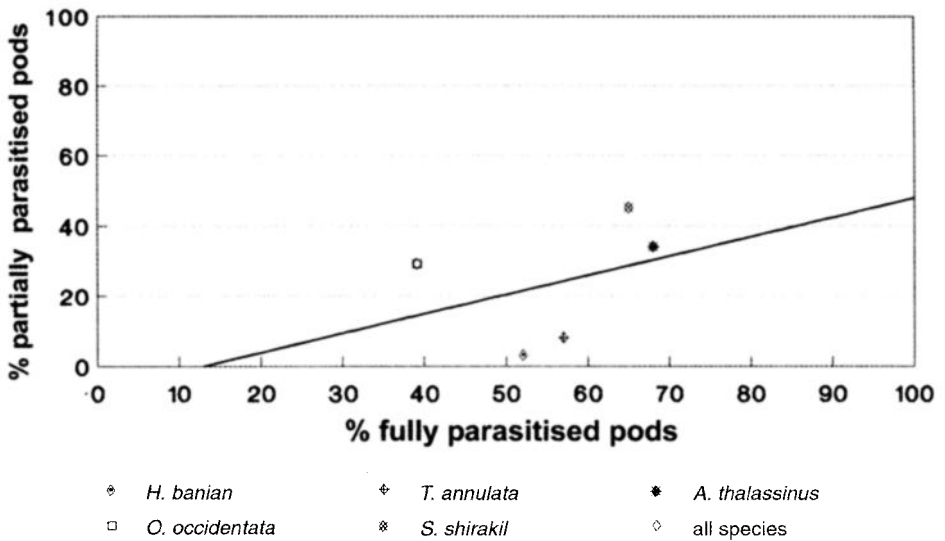


Fig. 3.11. Relationship between the proportion of pods fully parasitised by *Scelio* spp. and the proportion partially parasitised (after Irshad *et al.* 1978).

Parasitoids and predators

Trichomalopsis parnae Gahan (Pteromalidae) is reported as a hyperparasitoid of both *Scelio* and *Eurytoma* in the eggs of the smaller rice grasshopper, *O. hyla* (= *O. intricata* Stål), (Chui & Chou 1974). Given that hyperparasitism has not been recorded in numerous other studies, it must be considered as rare. Predators may be a significant mortality factor as they probably do not discriminate between parasitised and unparasitised host eggs. However, their potential impact on *Scelio* populations has not been assessed. In only one study (Baker 1975) has interspecific competition been reported, viz. between *Scelio* (nr. *S. javanicus*) and the dipteran predator *Stomorphina discolor* (F.) in egg beds of *L. m. migratorioides* in Papua New Guinea.

CONSERVATION UNDER PRESSURE FROM ENVIRONMENTAL CHANGE

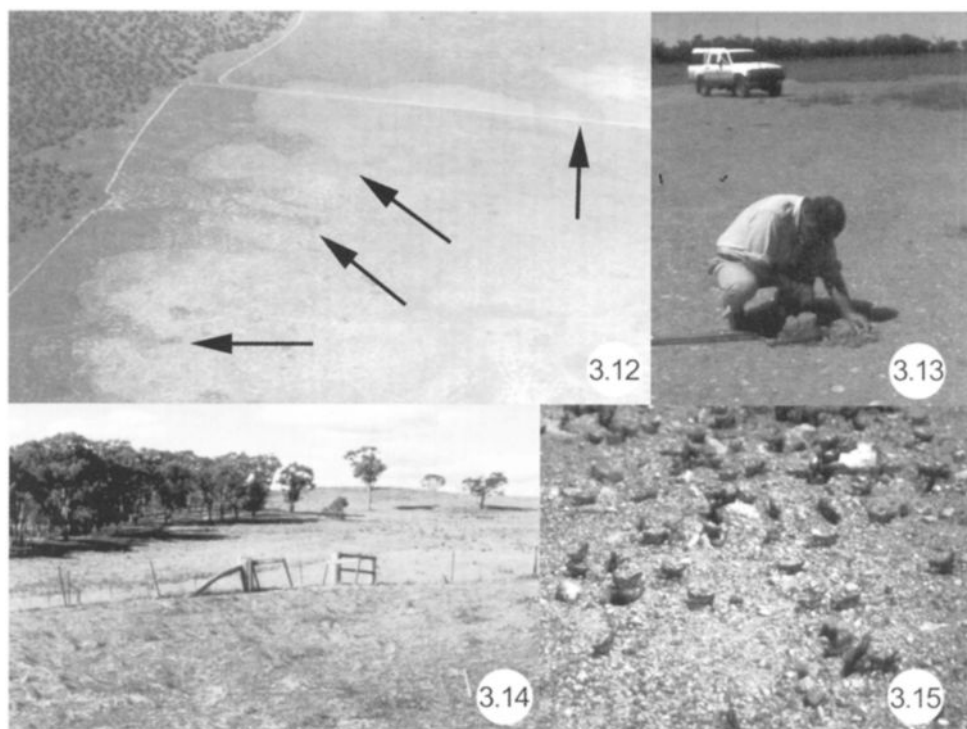
The most important factor impacting on species diversity of *Scelio* is habitat destruction. *Scelio* species exhibit site affinity, in addition to habitat preference, with the result that small

changes to an ecosystem may have disproportionate effects on their survival (Baker *et al.* 1996). Further, Acrididae and other Orthoptera are keystone ecosystem components (Quin *et al.* 1993; Samways 1997) and, consequently, their *Scelio* parasitoids are also likely to be an important part of many ecosystems. Lockwood and Ewen (1997) compared temporally disparate data from studies of *Scelio* conducted in North America by Parker and Wakeland in the 1930s and Dysart in the 1980s, and found an 80% reduction in parasitism. They speculated that *Scelio* may have been suppressed in recent times by human activity. Similarly, a long-term study of parasitism in Australia (Hunter *et al.* 1997) has shown a decline in *Scelio* since the mid 1980s (Fig. 3.8), coincident with the intensification of control campaigns against *C. terminifera*. However, the impact of recent control measures may not be the direct result of insecticide use, but may be indirect through their influence on host availability and the absolute abundance of *Scelio*. Preventative control in source areas since 1990 has reduced the intensity of outbreaks (APLC 1996), and this reduction in the amplitude of host population fluctuations (Hunter 1996) may have also lowered the amplitude of *Scelio* fluctuations. The high rates of parasitism recorded in residual populations at the end of 1979 and in early 1985 and 1988 (Fig. 3.8) may have been a consequence of the intensity of preceding locust plagues that allowed the full realisation of *Scelio* reproductive potential, resulting in optimum abundance. In Australia, increased carbon dioxide levels, and higher rainfall and temperatures associated with global warming are expected to have increased the extent and productivity of south-eastern rangelands by 2030, and to have reduced winter rainfall by 8% and increased temperatures by 2°C in the tableland grasslands (Hennessy 2000). The impact on acridids of such changes over such a short time frame is expected to be immense. Pest species such as *C. terminifera* will have a wider distribution and be prone to more frequent outbreaks if parasitoids do not exhibit concurrent distribution expansion or cannot adapt as readily as their host. Cold climate, high altitude species such as *Kosciuscola tristis* Sjöstedt may become extinct, together with any oligophagous *Scelio* parasitoids. However, a popular perception among landholders is that agriculture will successfully adapt to environmental change (Stevenson 2001) removing any political will by government to address the issue or monitor the impact of change on fauna such as pest locusts and grasshoppers.

AGRICULTURAL IMPORTANCE AND REGIONAL INCIDENCE

Nearly all locust and grasshopper pests are parasitised by species of *Scelio*, with a few notable exceptions such as *Sch. cancellata* in South America and *Camnula pellucida* (Scudder) in North America (COPR 1982; Pickford 1964; Dysart 1995, see also Chapter 4). Acridids whose density is modified by *Scelio* occur in a range of agricultural systems, e.g. pastures and rangelands where locusts such as *C. terminifera* are parasitised by *S. fulgidus* (Figs 3.12, 3.13) (Noble 1935), citrus orchards where *V. irregularis* is parasitised by *S. flavicornis* Dodd (Rajakulendran *et al.* 1993), horticultural crops where *P. vittatum* is parasitised by *S. improcerus* Dodd (Figs 3.14, 3.15) (Baker *et al.* 1985), and irrigated crops such as rice where *O. japonica* is parasitised by *S. pembertoni* (Pemberton 1933).

The economic benefit derived from the generally modest levels of parasitism by *Scelio* is readily apparent in the case of locusts, where host mortality proportionally reduces the area of gregarious populations and, consequently, the area requiring treatment. Such reductions in the area of hopper bands are particularly evident where the strategy of spot treatment is practised by landholders to control *C. terminifera* in south-eastern Australia and *Sch. gregaria* in districts of intensive agriculture in Africa (Symmons 1984, 1997a). For non-gregarious grasshoppers mortality reduces only density. It has no impact on the area infested, and therefore the area to be treated, except where host density is reduced below the economic threshold as a result of parasitism. For both locusts and grasshoppers, the economic benefits of parasitism by *Scelio* are often more subtle than simple host reduction. The apparent inverse



Figs 3.12–3.15. Habitat of important locust and grasshopper hosts of *Scelio*: **3.12.** Bands of Australian plague locust *Chortoicetes terminifera* (Walker) radiating out from egg beds (arrowed) at Goolgowi in the Riverina district of NSW, September 1979 (photo: Mr Don Kennedy). **3.13.** Sampling by Raymond Pigott to determine parasitism in a *C. terminifera* egg bed located in a red clay pan in the Hillston district of NSW, September 1987 (photo: Ms Maris Rea). **3.14.** 'Ambleside', Oberon, NSW, a typical improved pasture, habitat of wingless grasshopper, *Phaulacridium vittatum* (Sjöstedt) (photo: Mr Jack Salmon). **3.15.** Adult *P. vittatum* ovipositing in a denuded pasture (photo: Dr Roger Farrow).

host density dependence may allow host populations to be decimated, potentially extending the recovery time and, hence, the interval between host outbreaks (Baker *et al.* 1995). *Scelio* species are also an integral part of the ecology of agro-ecosystems. Fundamental biogeographical differences in host-parasitoid associations may occur in different regions or agro-ecosystems. For instance, polyphagy in *S. parvicornis* appears to be an adaptation necessitated by the periodicity of *C. terminifera* immigration (Baker *et al.* 1996), while oligophagy displayed by other species may derive from the spatial and temporal stability of host populations.

Some potential grasshopper pest species may be kept in check by *Scelio*. Baker *et al.* (1985) suggested that the relatively low pest status of *A. vulgaris* may be attributed to the high parasitism by *S. chortoicetes* in the southern tablelands of New South Wales. More generally, the moist temperate regions of Australia with relatively stable host populations appear to maintain parasitism at moderate levels. In regions subject to severe fluctuations in seasonal rainfall conditions, the role of *Scelio* parasitism in causing population fluctuations of locusts, such as *C. terminifera*, is seasonally variable (Hunter *et al.* 1997). Under marginal rainfall conditions parasitism may be non-productive with parasitised eggs desiccating, while under drought conditions both unparasitised and parasitised host eggs desiccate (see *Effect of wet conditions on abundance*, above). In the latter circumstance parasitism is regarded as dispensable mortality.

The species richness of natural enemies of acridid eggs appears to be lower on continents where *Scelio* predominate. In North America the impact on egg survival of a complex of coleopteran predators (Meloidae, Carabidae) exceeds that of *Scelio* (Rees 1973). In Australia, where *Scelio* species are abundant, egg predators are rare (Baker 1991). *Laius villosus* Lea (Melyridae) was recorded some 25 years ago (Farrow 1974b), while *Acridophagus flaviscutellaris* (Roberts) (*Cyrtomorpha flaviscutellaris* in lit.) (Bombyliidae) has not been sighted in New South Wales since the reports of Fuller (1938), despite extensive surveys since the mid 1970s (Baker *et al. unpubl. data*). It could well be that the absence of egg predators in Australia has allowed for greater speciation of *Scelio* species.

Some beneficial acridids, for example *Hesperotettix viridus* (Scudder) in North America, prefer host plants that have the potential to become weeds (Lockwood 1993a; Gangwere *et al.* 1997). Consequently, any control exerted on these acridids by *Scelio* may be regarded as environmentally detrimental, especially if the weed impacts on agricultural land. However, pastures and cultivated crops are important food sources for locusts and grasshoppers during plagues and, in general, any impact by *Scelio* is regarded as beneficial to agriculture.

NATURAL CONTROL OF HOST POPULATIONS: REGIONAL SURVEYS

Australia (see Tables 4.2 and 4.3)

In the eastern part of the continent, *C. terminifera* exhibits high parasitism by *S. fulgidus* throughout its range and this is supplemented in subcoastal invasion areas by *S. parvicornis*. Clark (1972) suggested a substantial role for *Scelio* in reducing host populations that are in decline through other causes, especially if the host population is relatively static. The factors initiating this decline are not known. However, chemical control and/or dry conditions are unlikely causes for an increase in *Scelio* abundance, although they frequently result in the decline of *C. terminifera* (Clark 1972; Symmons 1984). The only other factors commonly associated with a population decline are emigration (Farrow 1977) and parasitoids other than *Scelio* (Baker & Pigott 1993). These are also the most likely factors associated with an increase in *Scelio* abundance. For example, during prolonged occupation of an area by *C. terminifera*, emigration typically occurs each generation and mortality from other natural enemies increases simultaneously (Baker & Pigott 1995; Pigott *et al.* 1995).

During an outbreak of *C. terminifera* in 1984, mean parasitism rates of 50% (22–70%) were recorded in arid source areas. These caused discernible differences in the productivity of host generations in different districts of the outbreak area (Hunter 1985), with lesser parasitism recorded in the Riverina (Baker & Pigott 1986). In invasion areas, high parasitism rates have been recorded in immigrant populations, indicating an often substantial local base population of *Scelio*. Baker and Pigott (1995) reported 38% at Gundy in the Hunter Valley (New South Wales) in 1976, immediately following an influx; Hogan (1965) recorded 40% in the progeny of immigrant populations in eastern Victoria in 1955, and Baker and Pigott (1988) reported 15–20% in the Hillston district immediately following an influx of hosts from Queensland. Hunter *et al.* (1997), reporting on a long-term study between 1975 and 1983, gave an average value of $20 \pm 3.6\%$ when invasion takes place in summer, and $6.5 \pm 13\%$ when invasion takes place in autumn. The parasitism rate in the subsequent generation was lower following summer invasion (autumn: $13 \pm 3.1\%$) but increased sharply following autumn invasion (summer: $43 \pm 5.6\%$). Farrow (1977) reported >90% parasitism in the central-west of New South Wales following several local breeding generations in 1973. In subcoastal districts, *S. parvicornis* replaces *S. fulgidus* (Baker & Pigott 1993), and it has been suggested that the abundance of the former species is dependant on the frequent influx of *C. terminifera* for survival (Baker *et al.* 1996). In Western Australia, *C. terminifera* outbreaks

are less frequent than in the eastern part of the continent, but follow a similar outbreak pattern. Plagues develop in arid areas and migrate south-west to invade arable, subcoastal districts (Walden 1991, 1995). Parasitism by *Scelio* sp. (? *S. fulgidus*) and *S. parvicornis* is very patchy but increasingly important towards the later stages of the plague cycle (Dysart 1991; Walden 1995).

In 1981–82 in north-western New South Wales, two consecutive outbreaks of *C. terminifera*, one of local origin, the other of immigrants, were controlled by *S. fulgidus*. Parasitism by *S. fulgidus* was extremely high in the progeny of an immigrant population in December 1981 (mean 79%, range 54–97, $n = 5$) (Baker & Pigott 1983). This high rate is attributed to a high base population of *S. fulgidus* present after the collapse of an earlier outbreak in November 1981, during which parasitism was also high (mean 39%, range 25–56, $n = 4$). However, the progeny of a subsequent host influx in early January 1982 was poorly parasitised (mean 11%, range 3–24, $n = 3$), possibly because *Scelio* that had emerged in late November to early December 1981 had died or were otherwise not synchronised with the later influx.

A long-term study of *S. fulgidus* in eastern Australia (Hunter *et al.* 1997) indicated a recent slow decline in the level of parasitism since the early 1980s, in both the upper limit of the range as well as a lowering of the mean parasitism in all three regions studied (Fig. 3.8). This was coincident with increasingly intense control campaigns (Symmons 1984; APLC 1996), particularly in the arid source areas. However, given that parasitism rates appeared to have increased in the first half of the study, the fluctuations observed may represent long-term cyclical events unrelated to insecticide use. The intensity of control in invasion areas has declined since 1995, due to the more stringent application of environmental guidelines, and future trends may elucidate any association between the intensity of insecticide use and parasitism.

In the tableland and slope districts of eastern Australia, *G. musicus* is heavily parasitised by *S. gobar* (*S. bipartitus* *in lit.*) and was one of the key factors in initiating the collapse of an outbreak in 1978 (Baker 1978) when parasitism rates of 88% were recorded (Baker & Dysart 1992). However, a minor role by *S. gobar* was attributed to the decline of *G. musicus* outbreaks in the Mackay district of Queensland in the 1944–45 season (Mungomery 1945).

Austroicetes cruciata, a pest of winter cereal crops in southern Australia (Andrewartha 1944), is parasitised by *S. chortoi* (Andrewartha 1939; Birch 1945). The pest status of this grasshopper has declined remarkably in the last two decades through unknown causes.

Eggs of *P. vittatum*, a serious pest of improved pastures, are parasitised by *S. improcerus* and *S. parvicornis* consistently at levels around 30% (Clark 1967; Baker *et al.* 1995, 1996; Baker & Hill *unpubl. data*). However, mermithid nematodes are more important in regulating host populations of *P. vittatum*. Mermithids are seasonally variable and this accounts for the observed fluctuations in the density of *P. vittatum* associated with outbreaks and recessions (Baker 1995; Baker & Capinera 1997; Clift & Baker 1997). The role of relatively constant mortality, such as that caused by *S. improcerus* and *S. parvicornis*, is frequently overlooked and yet it may play a significant role in the population dynamics of acridids (Colvin & Holt 1996). Further, increasing this mortality by a small degree in the early phase of an outbreak cycle may afford effective control of outbreaks (Allen & Hoekstra 1992; Lockwood & Ewen 1997).

Aiolopus thalassinus, an occasional pest of coastal dairy pastures, is parasitised by *S. ignobilis* Dodd at levels of 22–60% (Baker *et al.* 1996). The host's preferred oviposition site is exposed contour banks and road cuttings that are also favoured by *S. ignobilis*. However, not all economic acridids in Australia are parasitised at significant levels. *Valanga irregularis*, a pest of citrus in inland New South Wales, is parasitised by *S. locustae* (*S. flavicornis* *in lit.*) (Rajakulendran *et al.* 1993) at rates of <16%. *Austracris guttulosa* Walker appears to be relatively unaffected by *Scelio*, with only a single instance of parasitism by *S. gobar* recorded

(Elder 1997). However, the dispersed egg laying of this host means assessment is infrequent. No *Scelio* have been recorded from *Monistria discrepans* (Walker) despite extensive egg rearing in search of natural enemies (Allsopp 1977, 1978).

Regions other than Australia (see Table 4.1)

In North America there is generally a low incidence of parasitism by *Scelio* and an absence of reports from several economically important acridids. In a review of biological control of rangeland grasshoppers in North America, Lockwood and Ewen (1997) concluded that parasitism may have declined recently as a result of human activity. They cite recent studies by Dysart (1995) in Montana in which egg parasitism of *Melanoplus bivitattus* (Say) averaged 4% compared with 16% in early studies by Parker and Wakeland (1957). The majority of host records from North America do not document incidence, indicating comparative rarity (Rees 1973; Siddiqui *et al.* 1986; Lockwood 1997). In South America, major pest species of locust such as *Sch. cancellata* have no recorded *Scelio* (COPR 1982), while parasitism levels of only 4.7 % have been recorded for an unidentified species parasitising *Scyllinops bruneri* (Rehn) (Silveira Guido & Carbonell Bruhn 1958). Although *Scelio* are found throughout the continent there are few host records. This general absence is unexpected given the ecological similarity between the drier parts of South America and Australia (De Santis and Loíácano 1995).

Parasitism levels for the most important locusts in Africa are generally low and the mortalities induced by *Scelio* are considered inconsequential in the outbreak dynamics of their hosts. The desert locust, *Sch. gregaria*, has been well studied and only modest rates of parasitism reported (10–15%) (Popov 1958; Greathead 1966; Greathead *et al.* 1994). Similarly, low parasitism levels by *Scelio* have been recorded for *Locusta migratoria* (L.) in the Sudan (Popov 1959) and Mali (Farrow 1975), and in a variety of acridids in Bénin (Shah *et al.* 1998). A high proportion of eggs of the red locust, *Nomodacris septemfasciata* (Serville), were reported as parasitised by *S. howardi* in Zambia in 1940, but this would appear to be an isolated instance (COPR 1982). There are no *Scelio* parasitoids recorded for several economically important species of acridid such as *Zonocerus variegatus* (L.) from west and east Africa, *Aiolopus strepens* (Latreille) in North Africa and *Oedaleus senegalensis* (Krauss) from the Saharan region. In well-studied hosts such as *Sch. gregaria*, *L. migratoria* and *N. septemfasciata*, egg predators are typically recorded at higher levels than *Scelio* (Popov 1959; Shah *et al.* 1998) and may have competitively displaced them as natural enemies of the egg stage.

There is also an absence of records of *Scelio* from the Palaearctic region (Uvarov 1977; Siddiqui *et al.* 1986; Rubtsov 1995), including well-studied hosts such as the Moroccan locust, *Docostaurus maroccanus* (Thunberg), which occurs throughout Europe and Central Asia (COPR 1982; Latchininsky & Launois-Luong 1992; Rubtsov 1995). An exception is *Scelio* sp. parasitising *Chorthippus* spp. in the United Kingdom at rates <66% (Richards & Waloff 1954).

Consistently low parasitism is reported in several species from the Indian subcontinent. Parasitism of the largely brachypterous rice grasshopper, *Hieroglyphus nigrorepletus* Bolivar, by *S. hieroglyphi* in India is reported in several studies as very low to moderate, viz. 0–15% (COPR 1982; Basavanna 1953b). Ahmed *et al.* (1973) and Irshad *et al.* (1978) also record similar low to moderate levels in the same region for several hosts (0.2–17%). However, for one host, *A. thalassinus* from Pakistan, parasitism of >30% has been reported (COPR 1982).

In south-east Asia parasitism by *Scelio* is high in the eggs of acridids infesting rice fields. Levels of >30% have been found in the eggs of *O. japonica* in Japan. However, the rates for acridids infesting grasslands is low (see Table 4.1). In China, *Scelio* has rarely been recorded from the migratory locust, *L. migratoria chinensis* Meyen (Ji 1985; Chen 1991), despite consistent moderate parasitism of *L. migratoria* documented in the Philippines (Goseco 1933) and Papua New Guinea (Baker 1975).

POTENTIAL AS BIOLOGICAL CONTROL AGENTS

At present, *Scelio* species cannot be regarded as possible candidates for the replacement of insecticides for the control of locusts or grasshoppers. The likelihood that any single biological control agent could ever regulate populations is unrealistic (Farrow 1989; Prior & Greathead 1989). There is still no agreement as to the relative role of climatic factors (Joern & Gaines 1990), biotic factors (Prior & Greathead 1989), and perhaps esoteric endogenous mechanisms (Lockwood & Lockwood 1997) in the population dynamics of locusts and grasshoppers. Thus, the key factor(s) best targeted for manipulation in any IPM program has not been identified. Until the relative importance of *Scelio* in the regulation of their hosts has been elucidated, the potential benefits of manipulating these wasps, either by supplementation with exotic species, augmentation, or through adoption of conservation strategies, will remain unknown.

Since the last major outbreak of *Sch. gregaria* in Africa in the late 1980s, there has been substantial discussion about the possibility of biological control as an alternative to chemical control (Lomer & Prior 1992; Goettel & Johnson 1997; Krall *et al.* 1997; Lomer *et al.* 2001). Parasitoids, including *Scelio*, have received scant attention, while bioinsecticides, namely those based on the fungal pathogens *Beauveria bassiana* (Balsamo) Vuillemin, *Metarhizium flavoviride* Gams & Rozsypal and *M. anisopliae* (Metschnikoff) Sorokin, are generally considered the most promising (Lomer & Prior 1992; Goettel & Johnson 1997). The use of fungal pathogens, dispersed as an ultra low volume (ULV) spray, appeals because they can be utilised in the same manner as insecticides with minimal conceptual, organisational or logistical change to current strategies (Symmons 1997b).

Skepticism about the potential inclusion of parasitoids in locust and grasshopper IPM programs has been expressed on the grounds that acridid hosts are innately more productive in that (1) their reproductive rate outstrips that of their parasitoids (Greathead 1992; Jago 1997), (2) they have delayed density dependent responses (Lockwood & Ewen 1997), and (3) they have evolved strategies such as migration to avoid attack (Farrow 1989). However, for many parasitoid–host associations, there is insufficient data on sex ratio, fecundity, frequency of oviposition, and generation time to make a comparison. Generation time may be seasonally variable, with the often shorter generation time of the parasitoid compensating for lower fecundity.

The impact of parasitoids on host populations is frequently underestimated due to the lack of study of natural systems (Lockwood & Ewen 1997) and discrepancies between observed or apparent parasitism and parasitoid induced mortality (Kaldor & Baker 1996). Under-estimation is especially pertinent in relation to *Scelio* where the mortality of eggs may exceed the percentage parasitised, due to the trapping of hatching grasshopper nymphs by unemerged parasitised eggs. The reproductive capacity of the parasitoid may also be elevated due to it having two generations to one of its host, e.g. diapausing *S. fulgidus* in overwintering *C. terminifera* eggs and a non-diapause generation that emerges in autumn and parasitises eggs of residual females from the same host generation (Baker *et al.* 1985). However, if oviposition by the host ceases due to emigration or drought, then there is no seasonal carryover of the *Scelio* population. There are few observations on the impact of natural enemies during the recessionary phase of an outbreak cycle, and yet impact during this stage may be exceedingly important in determining the duration of the recessionary phase and, consequently, the frequency of outbreaks (Colvin & Holt 1996). Extending the time between host outbreaks would have the same economic benefit as successful control of perhaps every third outbreak and at no cost. There is evidence that some parasitoids are extremely efficient, and Baker and Capinera (1997) have suggested that host conservation strategies, or built-in inefficiencies have evolved in order to prevent localised extinction of the host. Avoidance of these mechanisms may maximise the impact of an introduced parasitoid. This could be achieved by selecting for biotypes with, for example, a high

diapause temperature threshold, ensuring the entire population overwinters synchronously with the host.

The migratory ability of locusts is interpreted as a direct response to synoptic weather conditions (Farrow 1990), or its components temperature (Albrecht 1986), humidity (Casimir 1987) and food availability (Joern & Gaines 1990). The result of this behaviour is to bring them to areas suitable for sexual maturation and oviposition (Farrow 1990; D.M. Hunter *pers. comm.*). However, while rarely interpreted as a primary aim, migration has also been seen as a mechanism for escaping parasitism through long-distance movement, as in the case of *L. m. migratorioides* in Papua New Guinea (Baker 1975), or through the rapid colonisation of newly created breeding sites, as in the case of *P. vittatum* (Baker 1985). However, some *Scelio* are among the few parasitoids that have an adult stage with an ability to disperse with the host. Although probably rare among scelionines, phoretic behaviour such as in *Syn. bisulcata* (Muesebeck 1972; Lanham & Evans 1958), disperses attached wasps with their host, while others species such as *S. fulgidus* are transported downwind under the same synoptic weather conditions that induce host migration (Farrow 1981). However, a shift by the local base population of *Scelio* reproducing on alternative acridid hosts, is considered to be the main source of parasitism in invasion areas (Baker & Pigott 1993; Hunter *et al.* 1997). Generally, *Scelio* species have an unrealised reproductive capacity that is normally limited by the availability of hosts, and their full reproductive output is achieved only when there is a large influx of hosts.

Despite the relatively limited number of ecosystems occupied by pest acridids, disparate continental differences exist in parasitoid–host assemblages. For example, egg predators are apparently largely missing in Australia (Baker 1991), the *Scelio* fauna is depauperate in North America (Dysart 1983), and mermithid nematodes are poorly represented in Africa (Baker & Capinera 1997), while similar glaring continental differences occur in acridid–pathogen complexes (Milner 1985). On some continents there appears to be scope for consolidating the complex of biological control agents by ‘filling in the gaps’ and *Scelio* species are seen as having a key role to play in this area through the exchange of species between ecologically homologous areas (Siddiqui *et al.* 1986). However, the continental differences in natural enemy complexes are ancient, and the differences have themselves been subsequently compensated for by allowing expansion of other natural enemies (Baker & Poinar 1994). Most *Scelio* species probably have a limited scope in classical biological control programs, although the role of indigenous species may be improved through conservation, augmentation and enhancement strategies.

CLASSICAL BIOLOGICAL CONTROL

There are no instances of a pest acridid having been introduced or migrating from one country to another and achieving high pest status since the accidental introduction of *O. japonica* to Hawaii (COPR 1982). The spectacular intercontinental migrations of *Sch. gregaria* from Africa to the West Indies and islands in the Indian Ocean (COPR 1982) and *L. migratoria* from Africa to Northern Europe (Waloff 1954) have not resulted in establishment. However, intracontinental migrations in Europe have occasionally resulted in an extension of the species’ distribution, for example from the Danube delta to the Landes area of south-west France (Waloff 1954).

The rice grasshopper, *O. japonica*, was accidentally introduced into Hawaii around the turn of the century and had attained pest status by the 1920s (Pemberton 1933). In 1930, *S. serdangensis* and *S. pembertonii* were introduced to Hawaii from Malaysia. *Scelio serdangensis* failed in both culture and the field, but *S. pembertonii* established after the release of some 37 000 adults (Pemberton 1933). Lockwood and Ewen (1997) state this is the only instance of a biological control agent being introduced successfully against an acridid pest.

NEO-CLASSICAL BIOLOGICAL CONTROL

The term neo-classical biological control generally refers to the introduction of an exotic parasitoid for use against an indigenous host (Hokkanen & Pimentel 1984), although it has also been used to refer to new host associations involving indigenous agents and hosts. Several researchers (e.g. Waage 1990; Lockwood 1993a; Lockwood & Ewen 1997; Lockwood *et al.* 2000) perceive several important environmental disadvantages in this approach, while others maintain the risks to the diversity of hosts and their dependant parasitoids may be economically if not ecologically justified (DeBach & Rosen 1991).

Exotic parasitoid having the same endemic host

Some acridids have a wide geographical range over which the composition of their *Scelio* complex may differ. It is therefore possible to use an exotic, host specific, parasitoid against an indigenous host population. A typical example is the tropical migratory locust, *L. m. migratorioides* for which endemic *Scelio* parasitoids appear to be present throughout its range (COPR 1982): *S. sudanensis* Ferrière and *S. remaudierei* Ferrière in the Middle Niger (Popov 1959), *S. africanus* Risbec in Chad (Ackonor & Vajime 1995), *S. zolotarevsky* Ferrière in Madagascar (Wintrebert 1970), *S. uvarovi* in China (Ji 1985), *S. fascialis* Kieffer in the Philippines (Goseco 1933) and Japan (Tachikawa 1979), *Scelio* sp. (nr. *S. javanicus*) in Papua New Guinea (Baker 1975) and *S. gobar* (*S. bipartitus* in lit.) in Australia (Girault 1913a). There have been no quantitative studies of *Scelio* species over the range of *L. migratoria*, but a consistently poor performance by indigenous species would need to be demonstrated, and the reasons understood, before the introduction of an exotic parasitoid was contemplated. There is the possibility that some of the apparent geographic variation in the parasitoid complex is a consequence of erroneous taxonomy or taxonomic uncertainty and this should first be investigated (see *Importance of systematics to ecological studies* below).

Exotic parasitoid against a different endemic host

In North America, the introduction of exotic *Scelio* species has been considered on several occasions, with the susceptibility of indigenous acridids assessed for *Scelio* from Pakistan (Rees 1985) and Australia (Dysart 1992). The later study found a potential candidate for release (*S. parvicornis*), however no release was made due to environmental concerns (Lockwood 1993a, 1993b; Cunningham 1993; Carruthers & Onsanger 1993; El-Gammal *et al.* 1995; Lockwood & Ewen 1997; Lockwood 1997). The three main factors considered to be detrimental were (1) a potential wide host range, (2) a potential wide geographic 'spatially unbound' spread and (3) possible competitive displacement of indigenous *Scelio* species (Lockwood 1993a). The perceived benefits of the proposed introduction were a potential reduction in the extent and cost of chemical control with associated benefits for human health and the environment, including threatened and endangered fauna (Carruthers & Onsanger 1993). In a recent review of grasshopper and locust biological control, Lomer *et al.* (2001) argue that the high rates of efficacy of some oligophagous *Scelio* in Australia, point to the potential for new associations that have not yet been adequately explored.

Concerns regarding adaptation to a wide range of acridid hosts should be moderated by the fact that host range testing is typically conducted under artificial conditions in the laboratory and may not be readily extrapolated to the field, even in regard to the target host species (Sands 1997). Dysart (1997) found naked, stored *M. sanguinipes* egg pods were readily parasitised by *S. parvicornis* and it could be argued that the stimuli for parasitism were overcome by presenting eggs at a late stage in the host selection process. Concerns regarding spread also need to be moderated. The distribution of *Scelio* species are not spatially unbound. Host distribution is an important factor, yet many species sharing the same host have parapatric distributions throughout the distribution of their host. For some species,

sympatry with the host is incomplete, and the discrepancy for both parapatric and sympatric species is due to incompatible physical environments. The competitive displacement of indigenous *Scelio* is perhaps the only likely detrimental outcome, but this is of paramount importance (Lockwood 1993a). Any reduction in biodiversity is unconscionable given the expected demands on existing *Scelio* fauna to adapt to climatic change and host loss through habitat destruction in coming decades.

While the detrimental impact of chemical insecticides on the environment is considered immeasurably more deleterious than the consequences of reduced abundance of a grasshopper or parasitoid through the release of a biological control agent, it is also highly unlikely that the release of a single parasitoid would dispense with the need for continued use of insecticide. However, should chemical insecticides be replaced with environmentally benign bioinsecticides and phytochemicals in the control of locusts and grasshoppers, then the potential complimentary control that may be afforded by the introduction of exotic parasitoids may need reappraisal (Lomer *et al.* 2001). Should localised extinctions of *Scelio* species occur as a consequence of failure to adapt to rapid environmental change, it may be considered desirable to fill vacated niches by introducing exotic species that are preadapted to the new environmental conditions.

CONSERVATION THROUGH MODIFYING INSECTICIDE CONTROL STRATEGIES

Insecticides used in locust control campaigns are highly toxic to *Scelio* (Anon. 1994; Baker & Davison *unpubl. data*). However, temporal separation of peak abundance of adult wasps and intensive use of insecticides minimises the impact of chemical control. Increased knowledge of the course of plagues allows the preventative control of small areas early in the outbreak cycle. Also prediction of the onset of the recessionary phase may allow curtailment of a control campaign. Both strategies reduce the amount of insecticide used and minimise the impact of control campaigns on natural enemies, including *Scelio*. For example, the emergence of adult *S. muraii* does not occur until well after the host has hatched and after any insecticidal control. Consequently, in Japan control of *O. japonica* with DDT, benxene hexachloride and parathion had no effect on parasitism by *S. muraii* (Miyashita 1963). However, the discrepancy between the time of host hatching and *Scelio* emergence is often only 1–3 weeks, and this time interval needs to be considered when developing a control strategy to conserve *Scelio*.

In Australia, NSW Agriculture and the Australian Plague Locust Commission (APLC) have adopted three strategies to minimise the impact of insecticides on the *Scelio* fauna during locust control campaigns. These are (1) no ground treatment of bands by farmers is undertaken in the vicinity of egg beds, (2) the cessation of aerial treatment of swarms once oviposition has commenced (Anon. 1994), and (3) non-treatment of immigrant swarms in autumn (Anon. 1994). Because of considerable regional differences in the economic damage caused by plagues and regional differences in the persistence of outbreaks, due largely to variation in the abundance of natural enemies (Baker & Pigott 1995), there is the potential to adopt regional strategies that differ in their intensity of chemical control.

‘Do-nothing’ strategies

While the need to protect crops from locust plagues is seldom disputed (Bullen 1972; Symmons 1984, 1997a; Wright 1986), in Australia there are regions where parasitoids are sufficiently abundant to control outbreaks of *C. terminifera* (Baker & Pigott 1995; Baker & Barchia 1997) and *P. vittatum* (Baker 1995), and a ‘do-nothing’ strategy can be adopted. Lockwood and Ewen (1997) have called for wider investigation of seasonally and regionally variable outbreaks of North American grasshoppers in the hope of developing regionally

based pest management strategies that take account of natural control by predators and parasitoids.

Non-treatment of bands in the vicinity of egg beds

Spot treatment of *C. terminifera* egg beds by landholders using ground equipment should be delayed until nymphs have attained the third instar. By this time nymphs have moved away from the egg beds where *S. fulgidus* adults are emerging (Anon. 1994). This policy is readily adhered to by landholders because it also ensures that hatching of *C. terminifera* is complete, that bands are at their most gregarious and present relatively small targets, and it is coincident with peak vulnerability of *C. terminifera* to insecticide.

Non-treatment of ovipositing swarms

The curtailment of spraying once oviposition has commenced allows the base population of *S. fulgidus* and *S. parvicornis* to parasitise host eggs unimpeded. This policy is readily adhered to by the APLC and NSW Agriculture: APLC because it aims for preventative control by suppressing locust populations early in the breeding sequence (i.e. nymphal and young adult stage), and NSW Agriculture because once oviposition has commenced the continuation of the plague is assured, requiring ground control of bands by landholders. It is therefore preferable to let egg laying take place and save resources for the subsequent campaign by farmers against hopper bands. There is also the possibility that eggs may not result in a plague due to the intervention of natural factors such as parasitism or desiccation of eggs, or dry conditions immediately following hatching that results in high mortality of hoppers. This policy was followed from 1954 to 1979, after which the control of immigrant swarms was pursued vigorously, even after laying commenced (Symmons 1984). However, the policy was reversed in 1986 because of (1) a subsequent drop in parasitism rates by *Scelio* (Hunter *et al.* 1997), (2) concern over the additional impact of insecticide usage on the environment (Baker & Hooper 1992; Hooper 1997), and (3) no alleviation of the need for farmers to control bands of the subsequent generation. With improved satellite-assisted survey of semi-arid source areas in the early 1990s, the APLC introduced preventative control involving early intervention. This has also reduced the treatment of reproductive locust populations in both source and invasion areas.

Non-treatment of immigrant swarms in autumn

Sexually immature locusts that undertake mass migration have fat reserves sufficient to mature and oviposit within days of arrival in the invasion area. Reproductive locusts may also migrate considerable distances and oviposit on arrival (Hunter *et al.* 1981; Hunter 1982; Penner *et al.* 1997), e.g. *C. terminifera* typically invades inland regions in autumn and lays eggs immediately (Hunter *et al.* 1981). This means that a spring control campaign against bands in invasion areas is inevitable and, consequently, it is preferable to reserve control resources for the spring campaign. The absence of treatment ensures that both the base populations of *S. fulgidus* and *S. parvicornis* (Baker & Pigott 1993), and immigrant populations of *S. fulgidus* that may have migrated with their host (Farrow 1981), have maximum impact on the immigrant host population.

Use of soft chemicals, phytochemicals and bioinsecticides

The efficacy of insecticides and bioinsecticides used for locust control against *Scelio* has rarely been assessed (Jago 1997), but the impact of insecticides on non-target arthropods is considered to be substantial (Everts & Ba 1997; van der Valk & Niassy 1997; Peveling *et al.* 1999). None of the insecticides used in locust control in Australia can be regarded as 'soft'. Field application rates of lindane (BHC), maldison, fenitrothion and fiprinol all achieved >85% mortality when tested against *S. fulgidus* (Baker & Davison *unpubl. data*).

Phytochemicals have been tested against several Australian acridid species (Jacobson 1986) and would not be expected to harm parasitoids. Bioinsecticides such as the microsporidian *Nosema locustae* Canning (Henry 1971) and the fungal pathogen *M. anisopliae*, which has been recently field tested against acridid pests in Australia (Baker *et al.* 1994; Hooper *et al.* 1995; Milner *et al.* 1997; Hunter *et al.* 1999, 2001), are unlikely to have an impact on *Scelio*, given their lack of activity against other parasitic Hymenoptera (Prior 1997). The apparent inverse host-density dependence of *Scelio* may result in benign bioinsecticides having an enhanced proportional impact, as has been found in the case of mermithid nematodes (Baker & Milner 1994) and the pathogen *N. locustae* (Schell & Lockwood 1997). Lomer *et al.* (2001) reinforce this idea in stating that 'an emerging theoretical framework for the role of entomopathogens as biological pesticides in IPM leads us to suppose that, if we can find ways to manipulate pathogen populations, we could have a lasting impact on pest populations and exploit their specificity to allow a full role for arthropod natural enemies, all for a minimal environmental impact.'

AUGMENTATION BY INUNDATIVE RELEASE

Augmentation of indigenous *Scelio* species in the field by inundative release to control locust and grasshopper outbreaks is generally not considered feasible due to the large number of parasitoids required, the lack of *in vitro* rearing techniques, and the logistics of storage and dispersal (White 1997). Despite these drawbacks, methods have been described for mass rearing *S. uvarovi* for release against *L. m. manilensis* (Megen) in China (Ji 1985). Should some of the above inherent difficulties be overcome as new technologies are developed, there are many circumstances in which augmentation of field populations may be considered advantageous, e.g. for species with outbreaks of long duration, or in regions where localised extinction of parasitoids may have occurred as a result of temporary lack of hosts, unfavourable climatic conditions or adverse land use changes.

ENHANCEMENT THROUGH ENVIRONMENTAL MANIPULATION

The role of *Scelio* may be enhanced by the manipulation of host densities through the operation of control campaigns and by physical changes to their habitat and landscape heterogeneity (Fig. 3.16).

Land-use changes

Land-use changes have been frequently implicated in the advent of locust and grasshopper outbreaks, such as *L. m. migratorioides* in northern Australia (Farrow 1974a, 1979, 1986) and *P. vittatum* in south-eastern Australia (Farrow & Baker 1993; Baker 1993). Conversely, landscape fragmentation through land-use change has led to the extinction of some acridid species (Rentz 1993, 1996; Samways & Sergeev 1997) and such extinctions are fatal for oligophagous *Scelio*. When land-use change causes an increase in acridid abundance, this has not been attributed to a detrimental effect on natural enemies. However, the unfavourable nature of cleared ridges for nematode parasites of *P. vittatum* has contributed to the pest status of this species (Farrow & Baker 1993). Also destruction of open woodland is implicated in a decline in the abundance of nemestrinid parasitoids of acridids on the western slopes of New South Wales (Baker & Barchia 1997). The impact of land-use change on host abundance is expected to have consequences for parasitism levels achieved by host-density dependent parasitoids such as *Scelio*, in a manner similar to its enhancement of disease transmission (Samways & Sergeev 1997). A return to original land-use patterns or further change has rarely been proposed to achieve an enhanced role for natural enemies, although when such changes have been documented, a subsequent increase in mortality from parasitoids and/or predators may result (Chen 1991; Farrow & Baker 1993).

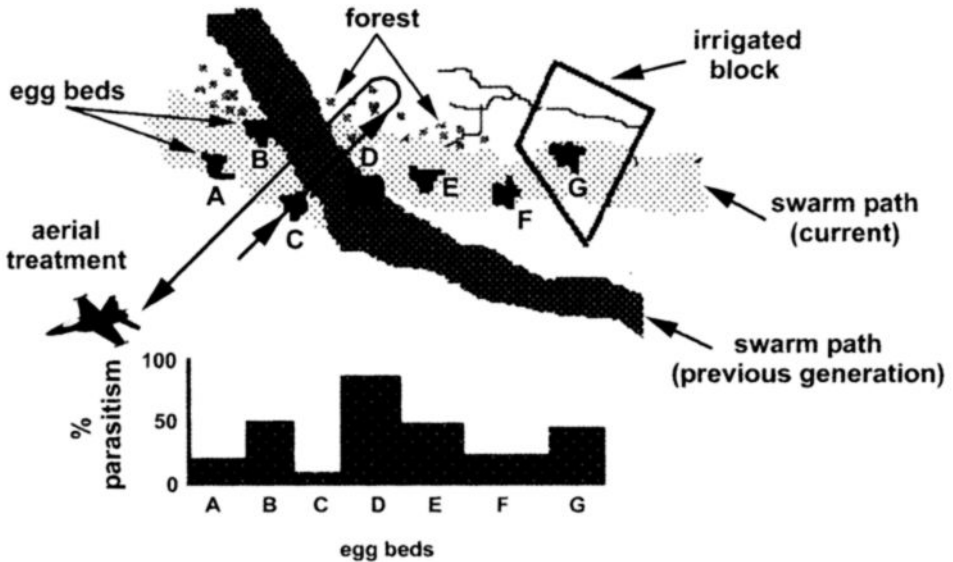


Fig. 3.16. Schematic representation of the impact of environmental factors on the level of parasitism by *Scelio*. The spatially variable parasitism exhibited by *Scelio* against a migratory locust is attributed to environmental factors as follows: (A) mean level in standard grassland habitat invaded for the first time (level dictated by base population of alternative hosts under prevailing seasonal conditions; Noble 1938); (B) rate elevated being adjacent to forested area favouring *Scelio* (Irshad *et al.* 1978; Baker *et al.* 1995); (C) rate reduced as host population aerially sprayed with insecticide at time of egg laying; (D) rate substantially elevated due to previous utilisation of the site by a former host generation (Baker & Pigott 1983); (E) rate elevated as area subject to ground spot treatment of bands in previous host generation; (F), as for (A) above; and (G) rate elevated due to flood irrigation, which prevented any desiccation (Mukerji 1987).

Host density changes during control

Many parasitoids of grasshoppers in North America are inversely host-density dependent (Lavigne & Pfadt 1966; Hostetter 1992) and, as control campaigns attempt to manipulate locust densities, they impact on parasitoid populations. Baker and Pigott (1995) were optimistic that increasingly efficient control of *C. terminifera* in arid source areas may enhance the impact of *S. fulgidus* and *S. parvicornis* in invasion areas. These species exhibit negative (i.e. inverse) host-density dependence, and so increasingly efficient control and reduced density of immigrant host populations may result in greater impact at an earlier stage in the outbreak cycle.

Intensity and coverage of control campaigns

Baker and Pigott (1995) have suggested that spot treatment of gregarious populations of *C. terminifera*, as occurs during preventative control campaigns, enhances the impact of parasitoids because the base population of parasitoids is relatively uniformly distributed. In comparison, treated host populations are highly aggregated, thus resulting in a disproportionate impact on them. However, by way of contrast Lockwood *et al.* (1988) have shown that broad area treatment of rangeland grasshoppers increases the severity and frequency of outbreaks. While the direct effect of insecticide use may be detrimental to non-target arthropods including parasitoids (Everts & Ba 1997), subtle beneficial impacts may result from host density reduction following such treatments. Reduced agents/area treatments (RAATs) trialled against grasshoppers in the western USA have produced a host population heterogeneity that favours parasitoids (Schell & Lockwood 1997).

IMPORTANCE OF SYSTEMATICS TO ECOLOGICAL STUDIES

The impact of systematic research in providing a solid framework for ecological studies has been stressed repeatedly over many decades. Simply put, it is impossible to conduct meaningful ecological research without being able to accurately and repeatably identify the species involved. This has been most poignantly demonstrated for biological control projects using parasitoids where taxonomic mistakes in the past have led to delays in the release of agents and/or failed programs, usually at substantial extra cost (LaSalle 1993; Schauff & LaSalle 1998). Numerous biological control projects have failed to include adequate taxonomic research in the initial stages of the program, and in some cases this has led to the misidentification of closely related species and even the mixing up of primary parasitoids and hyperparasitoids (LaSalle 1993; Schauff & LaSalle 1998). Schauff & LaSalle (1998) argue that an investment in systematics at the beginning of biological control programs is demonstrably cost effective.

Taxonomic problems impact not only on the accurate identification of natural enemies, but on pest species as well. The best example of this is highlighted by Noyes (1994), who described the search for natural enemies to control the cassava mealybug, *Phenacoccus manihoti* Matile-Ferrero, in tropical Africa. The mealybug was thought to originate from central America and the northern part of South America. However, parasitoids from this area failed to reproduce on mealybugs from the Congo region. It was subsequently realised that there were two closely related species of mealybug: one that was a new species from central America and northern South America, and *P. manihoti* from central South America. A parasitoid from the latter region, *Apoanagyrus lopezi* De Santis, has now provided successful control of cassava mealybug over most of its range in Africa.

One essential aspect of ecological research is the recognition by field biologists of the need to lodge voucher material in institutional collections. This aspect of ecological work is often neglected at the end of most studies, but voucher material is often critical to unravelling taxonomic and biological problems. Indeed, the taxonomic revision undertaken here (Chapter 8) has been able to utilise voucher material collected or reared in studies by Farrow and Baker, reported in this chapter. This material has been critical in resolving the taxonomy of *S. gohar* and *S. bipartitus*, and in determining the host range of several species (Dangerfield & Austin 1998; Chapter 4).

Host associations remain unknown for many incidental records of reared *Scelio* because of the lack of keys to host eggs. Some published host records are possibly erroneous because they were based on a circumstantial association with the dominant acridid species at the collection site. Even when host nymphs from the same pod are available for identification, the lack of published keys to first instar nymphs may also lead to erroneous host associations. There is an obvious need for more taxonomic research such as that by Popov (1989; Popov *et al.* 1990), which enables accurate identification of associated host stages (eggs and first instar nymphs). This deficiency is currently being rectified for the Australian acridid fauna (Rentz & Lewis *pers. comm.*).

Modern systematics now provides a range of powerful quantitative and molecular techniques that can provide very detailed and accurate results for revealing the presence of cryptic species, geographic differences in biology including host ranges, and relatedness of taxa. For example, cladistic biogeographic methods have recently shown that the Chinese wax scale, *Ceroplastes sinensis* Del Guercio, a polyphagous pest occurring in Europe, USA and Australasia, undoubtedly originated from South America. This is where a search for parasitoids should focus, not China as the name *sinensis* implies (Ting-Kui *et al.* 1994; Ting Kui & Gullan 1998). DNA sequence techniques now provide data amenable for examining a range of taxonomic problems from higher level phylogenetic questions to differences among strains, biotypes and populations (e.g. DeBarro & Driver 1997; DeBarro *et al.* 2000). Such techniques will, in the future, undoubtedly improve taxonomic knowledge of *Scelio* species and their hosts, and provide a more accurate framework for interpreting intra- and interspecific ecological studies.

CHAPTER 4

Host Relationships

Scelionids, like many groups of micro-Hymenoptera, generally display a relatively high degree of host specificity, showing hierarchical host relationships from subfamily to the species level (Galloway & Austin 1984; Austin & Field 1997). At higher taxonomic levels, such as within the subfamily Scelioninae, members of the tribe Baeini only parasitise the eggs of spiders (Araneae), the Gryonini are known only from heteropteran eggs, and the Embidobiini only from the eggs of embiids. Several tribes are associated exclusively with orthopteran eggs as hosts and, as discussed by Austin and Field (1997), the 55 genera comprising these tribes have a telescopic ‘*Scelio*-type’ ovipositor system (see Chapter 5), viz. the Scelionini, Calliscelionini, Psilanteridini, Cremastobaeini and Platyscelionini. Of these the Scelionini *s. str.* is the only tribe restricted to the Acrididae as a host group, and very rarely to Pyrgomorphidae (Pakistan and N.E. Africa only; Table 4.1). Members of the other tribes have been reared from the eggs of other orthopteran families, e.g. Tettigoniidae, Gryllidae or Rhaphidophoridae. However, this pattern of host group specificity should be treated with some caution given that the hosts of about three-quarters of all recognised scelionid genera are yet unknown and for many large genera their assumed host group(s) comes from only one or two records.

Table 4.1. Host associations of non-Australian Scelionini recorded in the literature. References listed in Siddiqui *et al.* (1986) are not included, only those that provide additional information are given. (N.B. all hosts belong to Acrididae unless otherwise indicated.)

Species	Hosts	Distribution	Parasitism (%)	Reference
<i>Scelio</i>				
<i>aegyptiacus</i> Priesner	<i>Aiolopus thalassinus</i> (F.)	Pakistan	31.3	COPR 1982
	" "	Pakistan	7	Siddiqui <i>et al.</i> 1986
	<i>Atractomorpha a. blanchardi</i> (Guérin)(P)	Pakistan	–	Siddiqui <i>et al.</i> 1986
	<i>Chrotogonus trachypterus</i> (Blanchard)	Pakistan	–	Ahmed <i>et al.</i> 1973
	<i>Oedaleus abruptus</i> (Thunberg)	Pakistan	–	Ahmed <i>et al.</i> 1973
	<i>Oxya hyla</i> Serville	Pakistan	0.2–14	Siddiqui <i>et al.</i> 1986
	<i>Shirakiacris shirakii</i> (Bolivar)	Pakistan	6	Siddiqui <i>et al.</i> 1986
	<i>Stenohippus</i> sp.	Pakistan	0.3–17	Siddiqui <i>et al.</i> 1986
	<i>Trilophidia annulata</i> (Thunberg)	Pakistan	13–15	Siddiqui <i>et al.</i> 1986
	<i>Acorypha glaucopsis</i> (Walker)	E. Africa	–	Greathead <i>et al.</i> 1994
	<i>Cataloipus fuscocoeruleipes</i> (Sjöstedt)	Benin	0–3.3	Shah <i>et al.</i> 1998
	<i>Hieroglyphus daganensis</i> Bolivar	Benin	0–3.3	Shah <i>et al.</i> 1998
	<i>Kraussaria angulifera</i> (Krauss)	Benin	0–3.3	Shah <i>et al.</i> 1998
<i>africanus</i> Risbec	<i>Locusta migratoria</i> (L.)	E. Africa	–	Greathead <i>et al.</i> 1994
	" "	E. Africa	low	Ackonor & Vajime 1995
	<i>Tylotropidius gracilipes</i> Branscik	Benin	0–3.3	Shah <i>et al.</i> 1998
	<i>Chondracris rosea</i> (DeGeer)*	Taiwan	–	COPR 1982
	<i>Eyprepocnemis plorans</i> (Charpentier)	Mali	–	Siddiqui <i>et al.</i> 1986
<i>bipartitus</i> Kieffer	" "	Sahel	–	Greathead <i>et al.</i> 1994
<i>cheops</i> Nixon	" "	"	–	"

(continued on next page)

Table 4.1 continued

Species	Hosts	Distribution	Parasitism (%)	Reference
<i>commixtus</i> Muesebeck	<i>Schistocerca americana</i> (Drury)	Belize	—	Siddiqui <i>et al.</i> 1986
<i>corion</i> Nixon	<i>Sherifurina haningtoni</i> Uvarov	Mali	—	Siddiqui <i>et al.</i> 1986
	<i>Acrotylus</i> spp.	Oman	—	Siddiqui <i>et al.</i> 1986
<i>ernstii</i> Riley	<i>Schistocerca</i> spp.	Venezuela, Mexico	—	Siddiqui <i>et al.</i> 1986
	<i>Schistocerca americana</i>	Central America	—	Siddiqui <i>et al.</i> 1986
	" "	Belize	—	Siddiqui <i>et al.</i> 1986
	<i>Schistocerca piceifrons</i> (Walker)	Guyana	—	Siddiqui <i>et al.</i> 1986
<i>facialis</i> Kieffer	<i>Locusta migratoria</i>	Japan	—	Tachikawa 1979
	" "	Philippines	—	Siddiqui <i>et al.</i> 1986
<i>floridanus</i> Ashmead	<i>Melanoplus differentialis</i> (Thomas)	USA	—	Siddiqui <i>et al.</i> 1986
	<i>Melanoplus sanguinipes</i> (F.)	Canada	—	Siddiqui <i>et al.</i> 1986
<i>gaudens</i> Nixon	<i>Chrotogonus senegalensis</i> Krauss	Africa	—	Kevan 1959
	<i>Chrotogonus</i> sp.	Mali	—	Siddiqui <i>et al.</i> 1986
	<i>Eyprepocnemis plorans</i>	Mali	—	Siddiqui <i>et al.</i> 1986
	<i>Trilophidia</i> sp.	Mali	—	Siddiqui <i>et al.</i> 1986
<i>hieroglyphi</i> Timberlake	<i>Aiolopus thalassinus</i>	Pakistan	—	CIBC 1975
	<i>Chrotogonus trachypterus</i>	Pakistan	—	Ahmed <i>et al.</i> 1973
	<i>Hieroglyphus banian</i> (F.)	Pakistan	15	Basavanna 1953b
	" "	Pakistan	7	Siddiqui <i>et al.</i> 1986
	<i>Hieroglyphus nigroropletus</i> Bolivar	India	—	Siddiqui <i>et al.</i> 1986
<i>howardi</i> Crawford	<i>Acrida</i> sp.	Tanzania	—	Siddiqui <i>et al.</i> 1986
	<i>Catantops axillaris</i> (Thunberg)	Malawi	—	Siddiqui <i>et al.</i> 1986
	<i>Kraussaria angulifera</i> (Krauss)	Nigeria	—	Siddiqui <i>et al.</i> 1986
	<i>Locusta migratoria</i>	Mali	—	Siddiqui <i>et al.</i> 1986
	<i>Morphacris fasciata</i> (Thunberg)	Ghana	—	Chapman 1962
	<i>Nomadacris septemfasciata</i> (Serville)	Nigeria	—	Siddiqui <i>et al.</i> 1986
	" "	Zambia	—	Lounsbury 1910
	" "	Tanzania	—	Hemming 1964
	" "	Malawi	—	Smee 1940
	" "	Mozambique	—	Cardoso 1937
	" "	Zimbabwe	—	Jack 1936
	<i>Patanga septemfasciata</i> (Serville)	Nigeria	—	Siddiqui <i>et al.</i> 1986
<i>hyalinipennis</i> Ashmead	<i>Chortophaga viridifasciata</i> (DeGeer)	USA	—	Siddiqui <i>et al.</i> 1986
	<i>Schistocerca obscura</i> (F.)	USA	—	Siddiqui <i>et al.</i> 1986
	<i>Melanoplus differentialis</i>	USA	—	Siddiqui <i>et al.</i> 1986
<i>indicus</i> Ashmead	<i>Patanga succincta</i> (L.)	India	—	Siddiqui <i>et al.</i> 1986
<i>javanicus</i> Roepke	<i>Valanga nigricornis</i> (Burmeister)	Indonesia	—	Siddiqui <i>et al.</i> 1986
nr <i>javanicus</i>	<i>Locusta migratoria</i>	Papua NG	30	Baker 1975
<i>mauritanicus</i> Risbec	<i>Catantops axillaris</i>	Tanzania	—	Siddiqui <i>et al.</i> 1986
	<i>Cataloipus fuscocoeeruleipes</i> (Sjöstedt)	Benin	0–3.3	Shah <i>et al.</i> 1998
	<i>Eyprepocnemis plorans</i>	Ethiopia	—	Siddiqui <i>et al.</i> 1986
	<i>Hieroglyphus vlaganensis</i> Bolivar	Benin	0–3.3	Shah <i>et al.</i> 1998
	<i>Kraussaria angulifera</i> (Krauss)	Benin	0–3.3	Shah <i>et al.</i> 1998
	<i>Ochrilidia gracilis</i> (Krauss)	Mali	—	Siddiqui <i>et al.</i> 1986
	<i>Pyrgomorpha</i> sp. (P)	N.E. Africa	—	Greathead <i>et al.</i> 1994
	<i>Tylotropidius gracilipes</i> Branscik	Benin	0–3.3	Shah <i>et al.</i> 1998

(continued on next page)

Table 4.1 continued

Species	Hosts	Distribution	Parasitism (%)	Reference
<i>?mauritanicus</i>	<i>Eyprepocnemis rosae</i> Uvarov	Pakistan	2	Siddiqui <i>et al.</i> 1986
<i>muratii</i> Watanabe	<i>Oxya japonica</i> (Thunberg)	Japan	41	Muria 1957
	<i>Oxya velox</i> (F.)	Japan	—	Siddiqui <i>et al.</i> 1986
	<i>Oxya yezoensis</i> Shiraki	Japan	—	Watanabe 1955
<i>nikolskyi</i> Ogloblin	<i>Locusta migratoria</i>	USSR	—	Siddiqui <i>et al.</i> 1986
<i>oedipodae</i> Ashmead	<i>Chortophaga viridifasciata</i>	USA	—	Siddiqui <i>et al.</i> 1986
	<i>Oedipoda</i> sp.	USA	—	Siddiqui <i>et al.</i> 1986
	<i>Schistocerca obscura</i>	USA	—	Siddiqui <i>et al.</i> 1986
<i>opacus</i> (Provancher)	<i>Ageneotettix deorum</i> (Scudder)	Canada	—	Siddiqui <i>et al.</i> 1986
	<i>Camnula pellucida</i> (Scudder)	Canada	—	Siddiqui <i>et al.</i> 1986
	<i>Melanoplus bivittatus</i> (Say)	USA	—	Siddiqui <i>et al.</i> 1986
	<i>Melanoplus packardii</i> Scudder	USA	4.8	Dysart 1995
	<i>Melanoplus sanguinipes</i>	Canada	—	Siddiqui <i>et al.</i> 1986
	<i>Melanoplus</i> spp.	USA, Canada	—	Siddiqui <i>et al.</i> 1986
	<i>Spharagemon equale</i> (Say)	USA	0.84	Dysart 1995
<i>oviphagus</i> Mukerji	<i>Hieroglyphus nigrorepletus</i>	India	—	Siddiqui <i>et al.</i> 1986
<i>ovivorus</i> (Riley)	<i>Dissosteira carolina</i> (L.)	Canada	—	Siddiqui <i>et al.</i> 1986
	<i>Melanoplus spretus</i> (Walsh)	USA	—	Siddiqui <i>et al.</i> 1986
<i>oxyae</i> Timberlake	<i>Oxya velox</i>	India	—	Siddiqui <i>et al.</i> 1986
	<i>Oxya hyla</i>	Taiwan	30	Siddiqui <i>et al.</i> 1986
<i>pakistanensis</i> Siddiqui <i>et al.</i>	<i>Aiolopus thalassinus</i>	Pakistan	—	Siddiqui <i>et al.</i> 1986
	<i>Oxya hyla</i>	Pakistan	—	Siddiqui <i>et al.</i> 1986
	<i>Shirakiacris shirakii</i>	Pakistan	—	Siddiqui <i>et al.</i> 1986
	<i>Spathosternum prasiniferum</i> (Walker)	Pakistan	—	Siddiqui <i>et al.</i> 1986
	<i>Stenohippus</i> sp.	Pakistan	—	Siddiqui <i>et al.</i> 1986
<i>pembertoni</i> Timberlake	<i>Oxya japonica</i>	Malaysia	—	Siddiqui <i>et al.</i> 1986
	" "	Hawaii (introd.)	—	Siddiqui <i>et al.</i> 1986
<i>popovi</i> Nixon	<i>Acrotylus</i> sp.	Oman	—	Siddiqui <i>et al.</i> 1986
<i>?popovi</i>	<i>Aiolopus thalassinus</i>	Pakistan	4	Siddiqui <i>et al.</i> 1986
	<i>Eyprepocnemis rosae</i>	Pakistan	5	Siddiqui <i>et al.</i> 1986
	<i>Stenohippus</i> sp.	Pakistan	7	Siddiqui <i>et al.</i> 1986
<i>princeps</i> Nixon	<i>Acrotylus longiceps</i> (Carpentier)	Oman	—	Siddiqui <i>et al.</i> 1986
	<i>Catantops axillaris</i>	Ethiopia	—	Nixon 1958
	<i>Heteracris littoralis</i> (Rambur)	Oman	—	Siddiqui <i>et al.</i> 1986
	<i>Ochrididia gracilis</i>	Oman	—	Siddiqui <i>et al.</i> 1986
<i>pulchripennis</i> Brues	<i>Acrotylus patruelis</i> (Herrick-Schaeffer)	Madagascar	—	Descamps & Wintrebert 1966
<i>remaudierei</i> Ferrière	<i>Acrida turrita</i> (L.)	Africa	—	Siddiqui <i>et al.</i> 1986
	<i>Aiolopus thalassinus</i>	Africa	—	Siddiqui <i>et al.</i> 1986
	<i>Duronia tricolor</i> Karny	Africa	—	Siddiqui <i>et al.</i> 1986
	<i>Duronia chloronota</i> (Stål)	Africa	—	COPR 1982
	<i>Locusta migratoria</i>	Africa	—	Siddiqui <i>et al.</i> 1986
	<i>Paracinema tricolor</i> (Thunberg)	Africa	—	Popov 1959
<i>rufulus</i> Muesebeck	<i>Camnula pellucida</i>	USA	2.4	Dysart 1995
	<i>Melanoplus bivittatus</i>	USA	0.03	Dysart 1995
	<i>Spharagemon equale</i>	USA	0.32	Dysart 1995
<i>semirufus</i> Muesebeck	<i>Mermiria maculipennis</i> Bruner	USA	—	Siddiqui <i>et al.</i> 1986

(continued on next page)

Table 4.1 continued

Species	Hosts	Distribution	Parasitism (%)	Reference
<i>serdangensis</i> Timberlake	<i>Melanoplus bivittatus</i>	USA	0.49	Dysart 1995
	<i>Melanoplus packardii</i>	USA	0.32	Dysart 1995
	<i>Oxya chinensis</i>	Malaysia	—	Siddiqui <i>et al.</i> 1986
	" "	Hawaii (introd.)	—	Siddiqui <i>et al.</i> 1986
nr <i>serdangensis</i>	<i>Atractomorpha a. blanchardi</i> (P)	Pakistan	0.4–6	Siddiqui <i>et al.</i> 1986
	<i>Eyprepocnemis rosae</i>	Pakistan	2	Siddiqui <i>et al.</i> 1986
	<i>Oxya hyla</i>	Pakistan	1–9	Siddiqui <i>et al.</i> 1986
	<i>Shirakiacris shirakii</i>	Pakistan	5	Siddiqui <i>et al.</i> 1986
	<i>Stenohippus</i> sp.	Pakistan	0.9	Siddiqui <i>et al.</i> 1986
	<i>Melanoplus bivittatus</i>	Canada, USA	—	Siddiqui <i>et al.</i> 1986
<i>sudanensis</i> Ferrière	<i>Melanoplus packardii</i>	USA	0.64	Dysart 1995
	<i>Melanoplus sanguinipes</i>	USA	0.08	Dysart 1995
	<i>Aiolopus thalassinus</i>	Nigeria	—	Siddiqui <i>et al.</i> 1986
	<i>Eyprepocnemis plorans</i>	N.E. Africa	—	Greathead <i>et al.</i> 1994
	<i>Eyprepocnemis</i> sp.	Mali	—	Siddiqui <i>et al.</i> 1986
	<i>Locusta migratoria</i>	Nigeria	low	Ackonor & Vajime 1995
	" "	Sudan	13.5	Popov 1959
	" "	Mali	10	Siddiqui <i>et al.</i> 1986
? <i>tristis</i> Nixon	<i>Patanga septemfasciata</i>	Mauritius	—	Uvarov 1924
	" "	Mali	—	Siddiqui <i>et al.</i> 1986
	<i>Schistocerca gregaria</i> (Forskål)	Africa	14	Popov 1958
	" "	Ethiopia	—	Siddiqui <i>et al.</i> 1986
	<i>Aiolopus thalassinus</i>	Pakistan	3–20	Siddiqui <i>et al.</i> 1986
	<i>Atractomorpha a. blanchardi</i> (P)	Pakistan	1–20	Siddiqui <i>et al.</i> 1986
	<i>Chrotogonus trachypeterus</i>	Pakistan	7	Siddiqui <i>et al.</i> 1986
	<i>Sphingonotus kashmirensis</i> Uvarov	Pakistan	13	Siddiqui <i>et al.</i> 1986
	<i>Spathosternum prasiniferum</i>	Pakistan	5	Siddiqui <i>et al.</i> 1986
	<i>Stenohippus</i> sp.	Pakistan	3	Siddiqui <i>et al.</i> 1986
sp. (unidentified)	<i>Trilophidia annulata</i>	Pakistan	6	Siddiqui <i>et al.</i> 1986
	<i>Brachaspis collinus</i> (Hutton)	New Zealand	—	Mason 1971
	<i>Chondracris rosea</i> (DeGeere)	Taiwan	—	Sonai 1940
	<i>Chorthippus</i> spp.	United Kingdom	<66	Richards & Waloff 1954
	<i>Nomadacris septemfasciata</i> (Seville)	Mauritius	—	Uvarov 1924
	<i>Phaneroptera furcifera</i> Stål	Philippines	—	Torreno & Ruguián 1987
	<i>Oxya japonica</i>	Japan	—	Siddiqui <i>et al.</i> 1986
	<i>Oxya velox</i>	Japan	—	Siddiqui <i>et al.</i> 1986
<i>uvarovi</i> Ogloblin	<i>Oxya yezoensis</i>	Japan	—	Watanabe 1955
	<i>Locusta migratoria</i>	China	10–90	Ji 1985
	" "	USSR	—	Siddiqui <i>et al.</i> 1986
<i>vulgaris</i> Kieffer	<i>Aeropedellus variegatus</i> (Fischer de Waldheim)	Russia	—	Rubtsov 1995
	<i>Chorthippus albomarginatus</i> DeGeer	USSR	—	Siddiqui <i>et al.</i> 1986
	<i>Chorthippus apricarius</i> (L.)	USSR	—	Siddiqui <i>et al.</i> 1986
	<i>Gomphocerus sibiricus</i> (L.)	USSR	—	Siddiqui <i>et al.</i> 1986

(continued on next page)

Table 4.1 continued

Species	Hosts	Distribution	Parasitism (%)	Reference
	<i>Locusta migratoria</i>	France	–	Siddiqui <i>et al.</i> 1986
	<i>Stenobothrus nigromaculatus</i> (Herrick-Schaeffer)	USSR	–	Siddiqui <i>et al.</i> 1986
	<i>Stenobothrus</i> spp.	Siberia	–	Vinokurov 1927
	<i>Stauroderus scalaris</i> (Fischer de Waldheim)	USSR	–	Siddiqui <i>et al.</i> 1986
<i>zlotarevskyi</i> Ferrière	<i>Aiolopus patruelis</i>	Madagascar	–	Descamps & Wintrebert 1966
	<i>Cryptacanthracris tatarica</i> (L.)	Madagascar	–	Descamps & Wintrebert 1966
	<i>Locusta migratoria</i>	Madagascar	–	Siddiqui <i>et al.</i> 1986
	" "	USSR	–	Siddiqui <i>et al.</i> 1986
<i>Sceliocerdo</i>				
<i>viatrix</i> Brues	<i>Neorthacris simulans</i> (Bolívar)	India	–	Ramchandra Roa 1952
	<i>Orthacris carli</i> Uvarov	India	–	Basavanna 1953a
<i>Synoditella</i>				
<i>bisulca</i> (Ashmead)	<i>Dichromorpha viridis</i> (DeGeer)	USA	–	Siddiqui <i>et al.</i> 1986
	<i>Melanoplus confusus</i> (Scudder)	USA	60	Siddiqui <i>et al.</i> 1986
	<i>Melanoplus femurrubrum</i> (DeGeer)	USA	10	Siddiqui <i>et al.</i> 1986
	<i>Melanoplus keeleri luridus</i> (Dodge)	USA	10	Siddiqui <i>et al.</i> 1986
	<i>Radnotatum carinatum</i> (Walker)	USA	–	Muesebeck 1972
<i>bisulcata</i> (Kieffer)	<u>from eggs</u>			
	<i>Melanoplus confusus</i>	USA	–	Siddiqui <i>et al.</i> 1986
	<i>Melanoplus differentialis</i>	USA	–	Muesebeck 1972
	<i>Melanoplus femurrubrum</i>	USA	–	Siddiqui <i>et al.</i> 1986
	<i>Melanoplus keeleri luridus</i>	USA	–	Siddiqui <i>et al.</i> 1986
	<i>Melanoplus sanguinipes</i>	USA	–	Siddiqui <i>et al.</i> 1986
	<u>phoretic on body of acridid</u>			
	<i>Dichromorpha viridis</i>	USA	–	Muesebeck 1972
	<i>Chortophaga viridifasciata</i>	USA	–	Muesebeck 1972
<i>Pseudoheptascelio</i>				
<i>cornopis</i> (Masner)	<i>Cornops aquaticum</i> (Bruner)	Trinidad	–	Masner 1972b

(P) refers to Pyrgomorphidae; rates of parasitism are discussed in Chapter 3; *host association considered erroneous; data in the older literature referring to USSR are generally not accurate enough to give new country locations).

HOSTS OF THE SCELIONINI

Compared with most tribes of scelionid wasps, the hosts of the Scelionini *s. str.* are relatively well known in that members of four of the 10 recognised genera are known to attack acridid species. These are *Scelio*, *Pseudoheptascelio* Szabó, *Sceliocerdo* Muesebeck and *Synoditella* Muesebeck (Masner 1972b; Muesebeck 1972; Austin & Field 1997; Table 4.1). Of these, the latter three genera comprise only five described species, four of which have host records, while for the 225 described species of *Scelio*, over 20% (49 species) have been reared from known hosts. This is the highest proportion of species with associated host information for any large genus of scelionid wasps.

HOSTS OF SCELIO SPECIES

The recorded hosts for *Scelio* summarised in Tables 4.1 and 4.2 are updated and corrected from an earlier list compiled by Siddiqui *et al.* (1986). These data reflect available host information as included in the published literature. We have not attempted to access unpublished records

Table 4.2. Acridid host associations of Australian *Scelio* spp. recorded in the literature and during this study (N.B. rates of parasitism are discussed in Chapter 3; note changes and corrections listed in Table 4.3)

Species	Hosts	Parasitism (%)	Reference
<i>chortoicetes</i> Froggatt	<i>Austroicetes cruciata</i> (Saussure)	–	Dodd 1927
	" "	–	Girault 1913a
	" "	–	Jenkins 1940
	<i>Austroicetes pusilla</i> (Walker)	–	Andrewartha 1939
	" "	–	Birch 1945
	" "	–	Weddell 1937
	<i>Austroicetes vulgaris</i> (Sjöstedt)	18.4	Baker <i>et al.</i> 1996
	<i>Gastrimargus musicus</i>	–	this study (Table 4.3)
	<i>Praxibulus insolens</i> Rehn	7.1	Baker <i>et al.</i> 1996
	<i>Aiolopus thalassinus</i>	–	Farrow 1982
nr. <i>flavicornis</i> Dodd <i>fulgidus</i> Crawford	<i>Chortoicetes terminifera</i>	0–63.1	Baker <i>et al.</i> 1996
	" "	–	Casimir 1962
	" "	–	Clark 1953
	" "	10–54	Clark 1972
	" "	0–43	Clark 1972
	" "	–	Davidson 1936
	" "	>90	Farrow 1977, 1981, 1982
	" "	–	Girault 1913a
	" "	–	Hogan 1955, 1965
	" "	<70	Hunter 1985
	" "	0–93	Hunter <i>et al.</i> 1997
	" "	–	Noble 1935
	" "	–	Veitch 1935
	" "	–	Weddell 1937
	<i>Gastrimargus musicus</i>	20	Baker <i>et al.</i> 1996
	<i>Locusta migratoria</i>	–	this study (Table 4.3)
	<i>Oedaleus australis</i> Saussure	–	Farrow 1982
	<i>Austracris guttulosa</i> (Walker)	–	Elder 1995
	<i>Chortoicetes terminifera</i> (Walker)	3.3	Baker <i>et al.</i> 1996
	<i>Gastrimargus musicus</i> (F.)	37.5	Baker <i>et al.</i> 1996
<i>gobar</i> Walker (<i>bipartitus</i> in lit.)	" "	87.5	Baker & Dysart 1992
	" "	92	Dodd 1927
	" "	moderate	Common 1948
	" "	plentiful	Mungomery 1944
	" "	low	Mungomery 1945
	<i>Locusta migratoria</i>	–	Girault 1913b
	" "	–	Jarvis 1916
	" "	–	Weddell 1937
	<i>Aiolopus thalassinus</i>	22–60	Baker <i>et al.</i> 1996
	? <i>Phaulacridium vittatum</i> (Sjöstedt)	25.0	Baker <i>et al.</i> 1996
nr. <i>ignobilis</i> Dodd <i>improcerus</i> Dodd	<i>Phaulacridium vittatum</i>	9.6	Baker <i>et al.</i> 1996
	<i>Macrotona australis</i> (Walker)	8.3	Baker <i>et al.</i> 1996
	<i>Chortoicetes terminifera</i>	1.6	Baker <i>et al.</i> 1996
<i>locustae</i> Dodd	<i>Valanga irregularis</i> (Walker)	16.6	Rajakulendran <i>et al.</i> 1993
(<i>flavicornis</i> Dodd in lit.)	<i>Praxibulus insolens</i>	7.1	Baker <i>et al.</i> 1996
<i>orientalis</i> Dodd	<i>Austroicetes vulgaris</i>	53	Baker <i>et al.</i> 1996
<i>parvicornis</i> Dodd	<i>Austroicetes cruciata</i>	–	this study (Table 4.3)
	<i>Brachyexarna lpbipennis</i> (Sjöstedt)	14	Baker <i>et al.</i> 1996
	<i>Chortoicetes terminifera</i>	7.2–20	Baker & Pigott 1995
	<i>Phaulacridium vittatum</i>	0.4–20	Baker <i>et al.</i> 1996
	" "	20–25	Baker <i>et al.</i> 1996
	<i>Gastrimargus musicus</i>	–	this study (Table 4.3)
<i>planithorax</i> Dodd			

associated with reared material in collection for non-Australian species. Given this limitation, some interesting geographic patterns are evident in that about one-quarter of all *Scelio* species with host associations come from the Oriental (26%) and Ethiopian (26%) regions, about 20% each from the Nearctic and Australian regions, followed by substantially fewer records from the Palearctic and Neotropical regions. All recorded hosts are from the Acrididae (some 80 species), although Pyrgomorphidae are also known as hosts on rare occasions. Three species of *Scelio* parasitise eggs of the pyrgomorphid *Atractomorpha a. blanchardi* (Guérin) in Pakistan, while one species has been reared from the eggs of *Pyrgomorpha* sp. in N.E. Africa (Table 4.1). However, in all instances the *Scelio* species involved also parasitise acridids, and it is possible that pyrgomorphids are utilised only as secondary or incidental hosts.

ERRONEOUS HOST RECORDS FOR AUSTRALIAN *SCELIO*

Table 4.2 presents the host records for the Australian region recorded in the literature and during this study. However, the taxonomic revision of Australian *Scelio* undertaken here (Chapter 8) has changed the status of a number of species and this has impacted on some host records reported in the literature. Table 4.3 presents the known host records for Australian species corrected for the taxonomic changes invoked in this study, and also includes new host information. In total, hosts are known for 10 (17%) of the 58 described Australian species. The most significant change is for *S. bipartitus* Kieffer, the host records of which have now been transferred to *S. gobar* Walker (Dangerfield & Austin 1998). *Scelio bipartitus* remains a valid species, but has been misinterpreted for the last 70 years and is now recognised only by the male sex (see discussion in Chapter 8). The taxonomic research undertaken here clearly shows that all of the host records previously associated with *S. bipartitus* should in fact go with *S. gobar*, which is known from both sexes. The record of *Chondracris rosea* (DeGeer) as a host for *S. bipartitus* from Taiwan (COPR 1982; Table 4.1) is undoubtedly based on an erroneous identification of the *Scelio* species involved. *Scelio bipartitus* is not known to occur outside of the Australian region.

Taxonomic changes also affect the potential host associations of two other species of Australian *Scelio*. *Scelio flavicornis* Dodd had previously been recorded in the literature as parasitising the eggs of *Chortoicetes terminifera* (Walker) and *Valanga irregularis* (Walker).

Table 4.3. Confirmed and corrected acridid host associations for Australian *Scelio* spp. based on taxonomic changes invoked in this study and information from label data examined directly

Species	Hosts	Source
<i>bipartitus</i> Kieffer	unknown	this study
<i>chortoicetes</i> Froggatt	<i>Austroicetes cruciata</i>	mat. examined
	<i>Austroicetes pusilla</i>	mat. examined
	<i>Austroicetes vulgaris</i>	mat. examined
	<i>Gastrimargus musicus</i>	mat. examined (n.r.)
<i>fulgidus</i> Crawford	<i>Chortoicetes terminifera</i>	mat. examined
	<i>Gastrimargus musicus</i>	mat. examined
	<i>Locusta migratoria</i>	mat. examined (n.r.)
<i>gobar</i> Walker	<i>Chortoicetes terminifera</i>	mat. examined
	<i>Gastrimargus musicus</i>	mat. examined
	<i>Locusta migratoria</i>	mat. examined
<i>ignobilis</i> Dodd	<i>Aiolopus thalassinus</i>	mat. examined
<i>improcerus</i> Dodd	<i>Phaulacridium vittatum</i>	mat. examined
<i>locustae</i> Dodd	<i>Valanga irregularis</i>	mat. examined
<i>parvicornis</i> Dodd	<i>Austroicetes cruciata</i>	mat. examined (n.r.)
	<i>Chortoicetes terminifera</i>	mat. examined
<i>planithorax</i> Dodd	<i>Gastrimargus musicus</i>	mat. examined (n.r.)

mat. examined, material examined; n.r. = new record; see Table 4.2 for source references and text for explanation

However, the latter is now known to be the host of *S. locustae*, which was treated as a synonym of *S. flavicornis* prior to this study. *Chortoicetes terminifera* may also be a host of *S. locustae*, but no reared material was found in any collection to validate the host status of this species. There may have also been potential confusion regarding the hosts of two new species described here, *S. jokentae* sp. nov. and *S. pigotti* sp. nov., which are very similar to *S. improcerus*. These new species may have been previously misidentified as *S. improcerus* using the key in Dodd (1927), and associated incorrectly with its hosts, *Phaulacridium vittatum* (Sjöstedt) and *Macrotona australis* (Walker) (Baker *et al.* 1995, 1996). This is particularly so for *S. jokentae*, which is partly sympatric with *S. improcerus*, although the latter species has been more commonly collected. To date, no reared material of *S. jokentae* sp. nov. or *S. pigotti* sp. nov. is available to confirm their host associations.

HOST SPECIFICITY

The degree of host specificity displayed by scelionid wasps is mostly inferred from rearing records of well-studied species; for few species has the host range been determined experimentally. However, both of these approaches have inherent problems. Rearing records may indicate a narrower range of hosts than is really the case, because other hosts have simply not been collected. Alternatively, under artificial (laboratory) conditions many parasitoids can be easily induced to oviposit (and develop) in hosts that they would otherwise reject under natural conditions, thus creating a much broader host range than is the case in the field (Sands 1997). Further, a simple list of hosts may hide the fact that host species are parapatric or allopatric, and that in any given part of the parasitoid’s distribution it may be highly host specific because none of its other hosts occur in that area.

Available data from well-studied species indicate that most scelionids are oligophagous, in that they parasitise a narrow range of hosts that are either related taxonomically or have similar biologies, or both. This generalisation appears to hold for *Scelio* species. Table 4.4 shows the number of host genera parasitised by species of *Scelio* worldwide: 50% are recorded from only one host genus, while 78% are recorded from three or fewer host genera. However, the host data presented in Tables 4.1–4.3 undoubtedly overestimates the host range of numerous species because it does not distinguish between records that are very rare or are derived from opportunistic ovipositions. For instance, of the hosts recorded for Australian *Scelio* (Baker *et al.* 1996; Tables 4.2 and 4.3), *Gastrimargus musicus* (F.) and *Locusta migratoria* (L.) are the major hosts of *S. gobar*, while *Austracris guttulosa* (Walker) and *C. terminifera* are rarer hosts and probably come from opportunistic events. This is also true for *S. fulgidus* Crawford for which *C. terminifera* is the primary host, and *G. musicus*, *Aiolopus thalassinus* (F.) and *Oedaleus australis* Saussure are rare hosts. Similarly, *C. terminifera* and *P. vittatum* are the primary hosts of *S. parvicornis* Dodd, and *A. vulgaris* and *Brachyexarna lobipennis* (Sjöstedt) have only been rarely recorded as hosts.

Table 4. 4. Number of host genera known for *Scelio* spp. worldwide (data compiled from Tables 4.1 and 4.3)

No. of host genera	No. of <i>Scelio</i> spp.
1	27
2	5
3	11
4	5
5	2
6	4
7	0
8	1

Scelio chortoicetes Froggatt is the only species known from Australia that is restricted to several species in one host genus, viz. *Austroicetes*: notably *A. cruciata* (Saussure) in South Australia and western NSW, and *A. vulgaris* (Sjöstedt) and *A. pusilla* (Walker) in the central-northern tablelands of NSW. However, a single specimen of this species has been recently identified as being reared from *G. musicus* (Table 4.3; Chapter 8) and, again, this is undoubtedly from a rare opportunistic oviposition, or the host was incorrectly identified.

Although there are well-defined host relationships for some Australian *Scelio*, these are almost exclusively species associated with pest acridids. The hosts of the great majority of *Scelio* species are unknown. Host information will be forthcoming only after undertaking detailed field studies over a wide range of habitats and focusing on locations, such as north Queensland and the Kimberleys, where there are concentrations of locally endemic *Scelio*.

CHAPTER 5

Morphology

The morphology of the Scelionidae has been outlined by Masner (1980), Galloway and Austin (1984) and Johnson (1984), while Masner and Huggert (1989) present a detailed account of the morphology of the Platygasteridae, most of which also directly relates to scelionids. Several specific character systems have also been examined in detail for the family. These include cephalic carinae (Masner 1979a; Mineo & Villa 1982a), antennal sensilla (Bin 1981; Bin *et al.* 1989; Isidoro *et al.* 1996), mesosomal morphology (Masner 1972a, 1979b; Mineo & Villa 1982b) and the ovipositor system (Galloway *et al.* 1992; Field & Austin 1994; Austin & Field 1997 - see below).

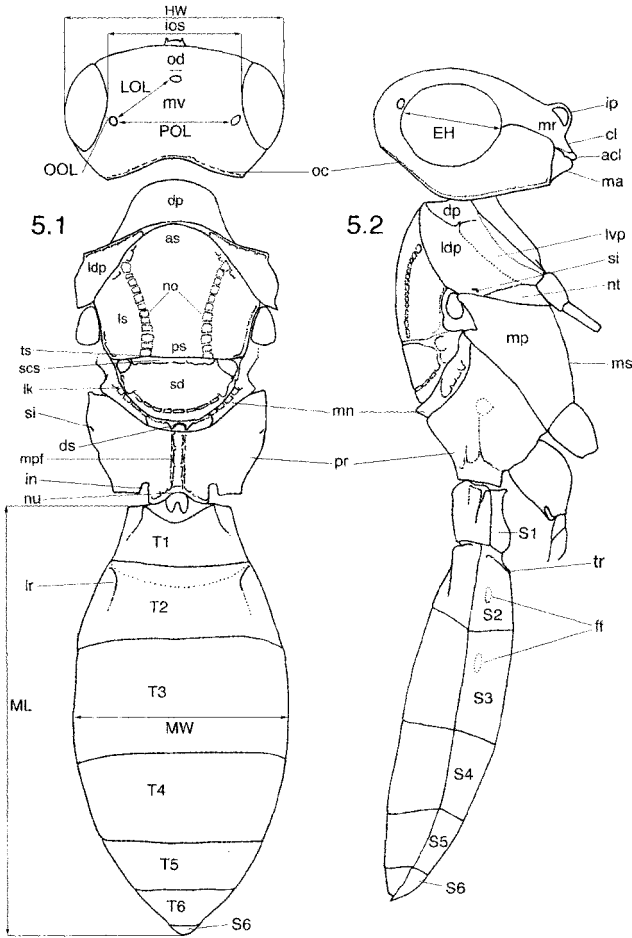
The terminology for morphological terms adopted here mostly follows Masner (1980) and Galloway and Austin (1984). The wing venation of scelionids is greatly reduced, and common names are usually adopted for the few veins present (see Galloway and Austin 1984). However, in the discussion presented below on the more complete venation seen in some extant and fossil scelionid genera, and the faint spectral traces that occur in some *Scelio* species, the terminology follows the modified Comstock-Needham system (after Sharkey & Wharton 1997). The terminology for sculpturing follows Eady (1968) and Harris (1979), and Johnson (1984) for male genitalia.

GENERAL CHARACTERISTICS

Scelio species are distinctly sexually dimorphic and the sexes differ with respect to antennal form (see Figs 5.6, 5.7), sculpturing (e.g. *S. chortoicetes* Froggatt, see Figs 8.30, 8.31) and colour pattern (Dangerfield & Austin 1998). In general, *Scelio* are medium to large in size relative to other scelionids, with a robust body (Figs 5.1, 5.2) and are usually heavily sculptured. The pilosity covering the body may be fine or modified into coarse thickened feather-like setae (see Fig. 8.193), particularly on the temples and dorso-lateral pronotum. Colour is variable and may include combinations of black, brown, orange or yellow. Males are brown to black, but the legs, tegulae and antennae may be brown, orange or yellow. Females show greater variation in colour among species, with some having bright orange coloration on the mesosoma or metasoma.

HEAD

The **head** is broadly oval-shaped in dorsal view with a concave occipital region (Fig. 5.1). The **ocelli** form a broad triangle on the vertex with a narrow ocular-ocellar gap or length (OOL). The **eyes** are moderately large and glabrous. The **frons** (fr) is large and extends from the anterior ocellus to below the level of the eyes (Fig. 5.3). The medial part of the frons is the **speculum** (sp), which is smooth but not raised or bordered by a carina. The antennae are attached below the level of the eyes, ventral to the speculum, and at either side of a raised **interantennal process** (ip Fig. 5.2). The **toruli** or **antennal sockets** are bordered by lateral carinae which usually continue around the antennal sockets but sometimes have carinae continuing dorsally onto the speculum. The lower lateral frons or **malar region** (mr) has variable but distinct sculpturing patterns. This sculpturing may be in the form of radiating striations from the corners of the clypeus, or may be punctate or reticulate. The **clypeus** (cl) is immediately ventral to the interantennal process. It has **lateral points** (cp) of variable



Figs 5.1, 5.2. Generalised morphology of adult *Scelio*: **5.1.** Dorsal view of body. **5.2.** Lateral view of body (see Table 5.1 for abbreviations).

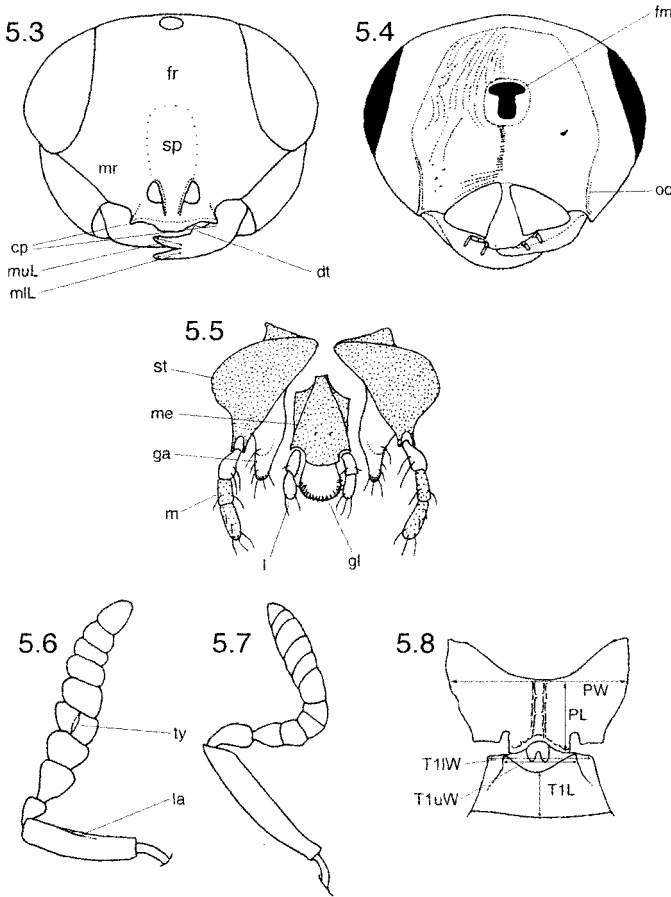
length and a **medial margin** which may be short or long and produced, and either square, slightly convex, or concave at the apex. The **anteclypeus** (acl) is a special name for the smooth, slightly raised area along the medial clypeal margin extending laterally to the points.

The **labrum** of the mouthparts is small, narrow, concealed behind the clypeus, and is only partially visible in those species where the clypeus is reduced or short (e.g. *S. miki* sp. nov. and *S. pilosifrons* Dodd, see Figs 8.149, 8.187). The **mandibles** (ma) are moderately large, robust and mostly overlap medially (Fig. 5.3). In only one species (females of *S. pilosifrons*, see Fig. 8.187) are the mandibles reduced, only just meeting medially, and have broadly rounded apical teeth. All males and the majority of females have two distinct apical **mandibular teeth** (i.e. bidentate) which may vary in length (mlL, muL). In only two species are the mandibles unidentate (e.g. female *S. chortoicetes*, see Fig. 8.32). Some species possess a **dorsal mandibular tooth** (dt) which is in line with the clypeal emargination between the lateral points and the

Table 5.1. Abbreviations for morphology and measurements

acl	anteclypeus	mr	malar region
ad	aedeagus	ms	mesosternum
as	anterior scutum	MS	malar space length
br	basal ring	mt	mandibular teeth
c	cardo	mu	muscle
cl	clypeus	muL	mandibular upper tooth length
cp	clypeal lateral points	mv	medial vertex
Cu	cubital vein	MW	metasomal width
di	digitus	nt	netrion
dp	dorsal pronotum	no	notaulus
ds	dorsellum	nu	nucha
dt	dorsal tooth of mandible	oc	occipital carina
EH	eye height	od	ocellar diameter
ff	felt field	OOL	ocular ocellar length
fm	foramen magnum	ov	ovipositor
fr	frons	PL	propodeal length
g	gonangulum	POL	posterior ocellar length
ga	galea	Pr	propodeum
gc	gonocoxae	ps	posterior scutum
gl	glossa	PW	propodeum width
gp	gonoplags	R1	radius
HW	head width	r	apical vein of stigma
in	indentation about nucha	ra	radicle
ios	interocular separation or dorsal distance between eyes	r-m	radio-medial cross vein
ip	interantennal process	Rs	radial sector
l	labial palp	S	sternite
la	lamella	Sc	subcostal vein
lap	lateral apodeme	scs	scutellar sulcus
ldp	latero-dorsal pronotum	sd	scutellum
li	ligula	se	sensilla
lk	lateral keel	si	spiracle
LOL	lateral ocellar length	smv	submarginal vein
lr	lateral ridges on T2	sp	speculum
ls	lateral scutum	ss	stigmal spot
lvp	latero-ventral pronotum	st	stipes
M	medial vein	T	tergite
m	maxillary palp	T7+8	fused abdominal tergites 8 & 9
ma	mandible	T1L	T1 length
me	mentum	T1lW	T1 lower anterior width
ML	metasoma length	T1uW	T1 upper anterior width
mlL	mandibular lower tooth length	tA9	tubular abdominal segment 9
mn	metanotum	tr	basal transverse ridge
mp	mesopleuron	ts	transscutal suture
mpf	medial propodeal furrow	tt	telescopic tube
		ty	tyloid
		vo	volsella

medial clypeal margin (e.g. *S. setafascis* sp. nov., see Fig. 8.213). Some species have an area of imbricate or reticulate sculpturing at the base or middle of the mandible. The **cardo** (c) of the maxillae is small and triangular (Fig. 5.5). The **stipes** (st) is broad, stout and heavily sclerotised. The **galea** (ga) are only slightly sclerotised at the apex while the **lacinia** is absent. The **maxillary palps** (m) are 3-segmented. The **labium** is relatively small, the **mentum** (me) is heavily sclerotised and the medio-apical margin may be concave or convex. The **labial**

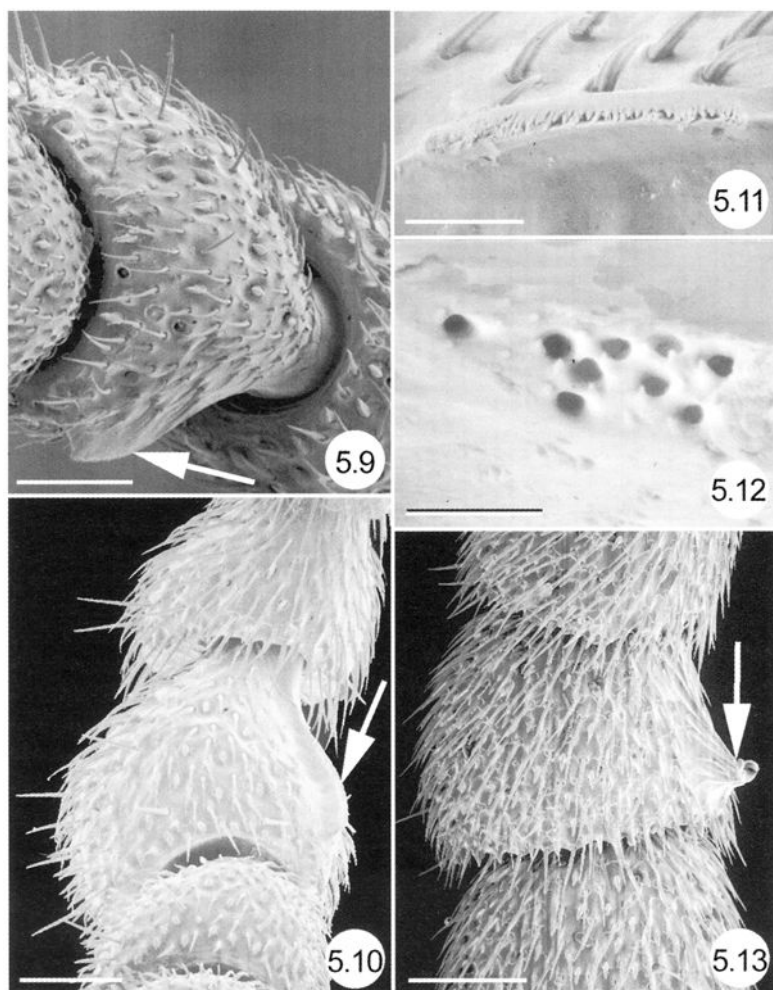


Figs 5.3–5.8. Generalised morphology of adult *Scelio*: 5.3. Anterior view of head. 5.4. Posterior view of head. 5.5. Anterior view of maxillae and labium. 5.6. Male antenna. 5.7. Female antenna. 5.8. Measurements of the propodeum and first metasomal tergite (see Table 5.1 for abbreviations).

palps (l) are 2-segmented. The **glossa (ligula)** (gl) is evenly rounded at the apex. The mouthparts are generally concealed by the mandibles in anterior view.

The **occiput** is defined by a weakly raised **occipital carina** (oc) or a change of sculpturing from that of the posterior vertex (Fig. 5.4). The occipital carina is always present ventrally but may be absent dorsally. The **foramen magnum** (fm) is small, mushroom-shaped and surrounded by a weak carina.

The joint between the scape and pedicel is geniculate and the scape has raised **lamellae** (la) forming a groove for reception of the pedicel. The **male antenna** is 10-segmented (Fig. 5.6) and has a variety of specialised sensilla. **Tyloids** (ty) may be present on the outer lateral surface of antennal segment 5, and vary from raised points (Fig. 5.13) to elongate longitudinal carinae which possess fine pores or brush-hairs along



Figs 5.9–5.13. Tyroids on the 5th antennal segment of male *Scelio*: **5.9.** Elongate tyloid of *S. bipartitus* Kieffer (arrowed). **5.10.** Elongate tyloid of *S. littoralis* Dodd (arrowed). **5.11.** Elongate tyloid of *S. asperatus* Dodd, showing brush-hairs along ridge. **5.12.** Elongate tyloid of *S. miki* sp. nov., showing pores along ridge. **5.13.** Raised node-like tyloid of *Scelio* sp. R (arrowed). Scale lines: 5.9, 5.10, 5.13, 50 μm ; 5.11, 10 μm ; 5.12, 2.5 μm .

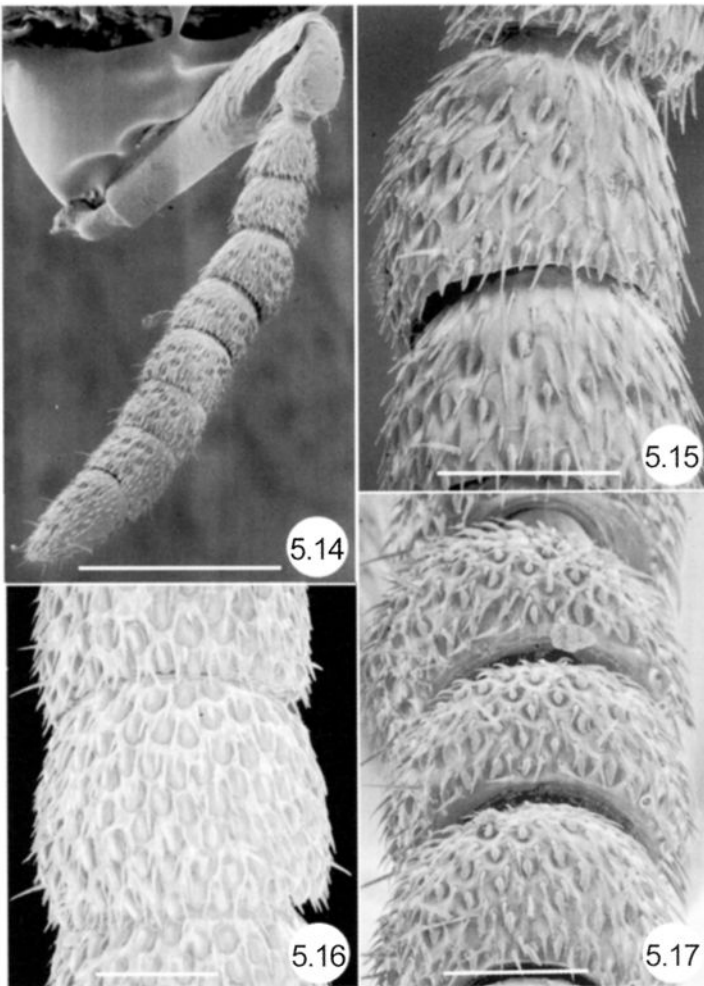
the apical edge (Figs 5.9–5.12). Often, when the tyloid is present, segment 5 may be broader than the other segments. In those species where tyroids are absent, other scattered sensilla may be more prominent, in particular basiconic pegs (Figs 5.14–5.17).

The **female antenna** is 12 segmented with an elongate scape, small triangular pedicel, and the funicle gradually expanding into a 6- or 7-segmented clava (Fig. 5.7). The antenna is geniculate at the joint between the scape and pedicel, and the clava is reflexed at the joint between funicle segment 4 and the clava. The ventral surfaces of the segments comprising the clava possess specialised sensilla (multiporous gustatory sensilla, previously referred to as basiconic or plate sensilla; Bin 1981; Bin *et al.* 1989; Isidoro *et al.* 1996), which are arranged in longitudinal pairs per segment (see Figs 8.119, 8.120). Usually there is a group of tiny setae between the specialised sensilla which form an ‘arrow’ pattern (see Fig. 8.106). The antennal

clava also ‘bristles’ with numerous other sensilla such as specialised pits, plates, pegs and stout hairs. At least some of these structures are probably homologous to the uniporous gustatory sensilla described for *Trissolcus* (Isidoro *et al.* 1996).

MESOSOMA

The pronotum can be divided into four distinct areas (Figs 5.1, 5.2). The **dorsal pronotum** (dp) is the area anterior to the scutum; the **latero-dorsal pronotum** (ldp) borders the lateral scutum and is often separated from the dorsal pronotum by a transverse carina synonymous with the **epomial carina** (Masner 1979b); the **latero-ventral pronotum** (lvp) is ventral to



Figs 5.14–5.17. Antennae of male *Scelio* that lack tyloids but have dense arrays of basiconic peg sensilla: **5.14.** *S. mannesi* sp. nov., whole antenna. **5.15.** *S. mannesi* sp. nov., high magnification. **5.16.** *S. improcerus* Dodd, high magnification. **5.17.** *S. setafascis* sp. nov., high magnification. Scale lines: 5.14, 0.2 mm; 5.15–5.17, 50 μ m.

the latero-dorsal pronotum and posterior to the dorsal pronotum and is separated from these areas by a carina. The latero-ventral pronotum may be smooth or sculptured apically. Postero-ventrally to the latero-dorsal pronotum is the **netrion** (nt), which is similar to, but not homologous with the prepectus of Chalcidoidea (Masner 1979b). Usually the netrion has the anterior margin defined by a furrow which may be obscured by carinate sculpture.

The mesoscutum is mostly evenly sculptured but may have the **anterior scutum** (as) smooth or with reduced sculpturing in contrast to the **posterior scutum** (ps). The anterior scutum never has a skaphion developed as in some other scelionid genera (Masner 1972a, 1976b). The **notauli** (no) may be absent (see Fig. 8.99) or represented by moderately deep carinate furrows (see Fig. 8.138, 8.143, 8.169), which may be partly obscured by dense sculpturing on the scutum (see Fig. 8.63). When present, the notauli remain broadly separated along their length and, when percurrent, they meet the **transscutal suture** (ts). The **scutellar sulcus** (scs) is narrow and deep, and bordered by reduced **axillae** laterally. The **scutellum** (sd) has an evenly convex posterior margin in dorsal view and is bordered by a carinate furrow and posterior smooth band. The latero-medial scutellum in some species has **lateral keels** (lk) (e.g. *S. varipunctatus* Dodd, Fig. 8.227); sometimes these are node- or spine-like and are referred to as **lateral nodes** or **lateral spines**, respectively. The **metanotum** (mn) is narrow and has a **dorsellum** (ds) medially. The dorsellum is always raised above the level of the lateral metanotum, but varies from being only slightly raised to very prominent, and may also be shallowly to deeply emarginate medially.

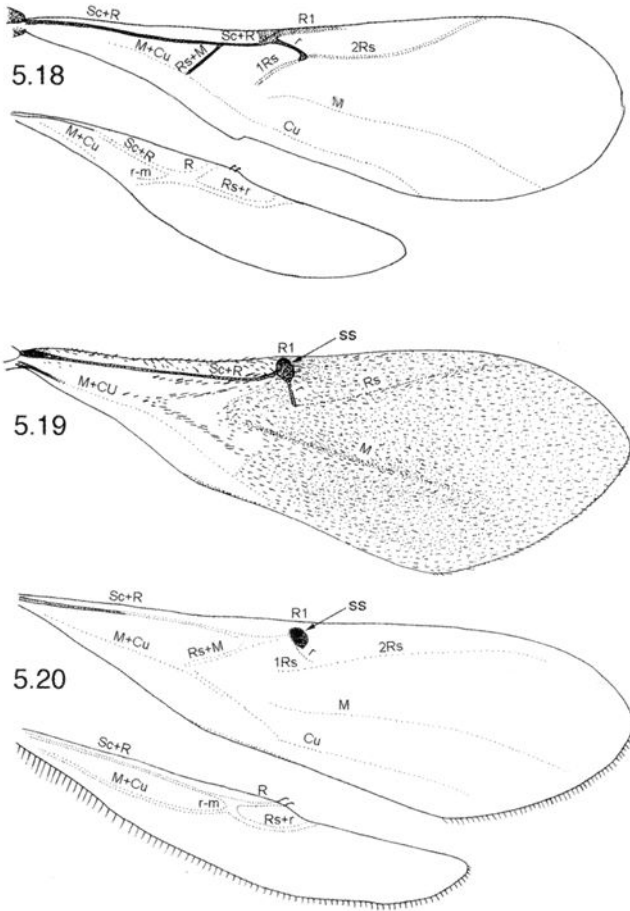
The **propodeum** (pr) is broader than long, variable in length, and has ovoid **spiracles** (si) positioned dorso-laterally (Fig. 5.1). There may be a medial longitudinal furrow which is either percurrent or only present in the anterior half. The **nucha** (nu) on the posterior margin is where the propodeum attaches to the metasoma. There are often **indentations** (in) on the propodeum either side of the nucha, which may be shallow or deep, broad or narrow. The postero-lateral corners of the propodeum may be rounded, square or apically pointed. The **mesopleuron** (mp) shows little variability in *Scelio* but sculpturing patterns may be transversely striate to punctate. The **mesosternum** (ms) may have coarse or fine sculpturing or may be completely smooth.

LEGS

Some scelionid genera such as *Acanthoscelio*, *Dicroscelio* and *Archaeoteleia* possess a clearly defined **trochantellus**, which, as far as known, is not present in any members of *Scelio*. The **coxae** are globular and increase in size from the fore to hind coxa. The fore **trochanter** is narrow and elongate, 2–3 times longer than the mid and hind trochanters. The **femora** are narrow basally expanding in the apical quarter. Males often possess greater swelling of the fore femur than females. The **tibiae** are narrow basally and expand gradually to the apex and have spines in the dorso-apical half. The fore leg tibial spur of all genera of Scelioninae is developed into a bifid **calcar**. The mid and hind legs have one setose apical tibial spur. The fore **basitarsus** is modified with a comb which is longest basally, becoming gradually shorter toward the apical third. Five **tarsomeres** are present. Tarsal **claws** are simple, and sometimes possess subapical setae. **Plantae** are small and simple with a central pulvilliform **arolium**.

WINGS

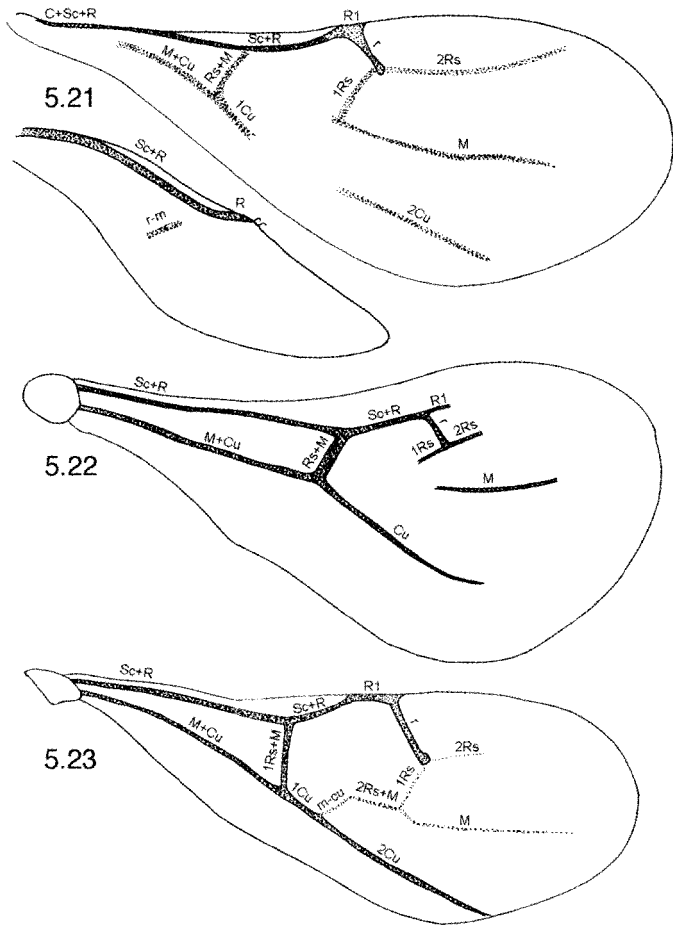
Like most Scelionidae, the venation of *Scelio* is greatly reduced (Figs 5.19, 5.20). Only the **submarginal** (Sc+R) and sometimes part of the very short marginal (R1) and **stigmatal** (r) veins of the fore wing, and the basal part of the submarginal vein in the hind wing are tubular. However, in many species of *Scelio* many or all of these veins are spectral. Further the marginal



Figs 5.18–5.20. Wings: 5.18. Fore and hind wings of *Archaeoteleia pygmae* Masner. 5.19. Fore wing of *S. miki* sp. nov. 5.20. Fore and hind wings of *S. petilus* sp. nov.

vein is very short and, with the basal part of the stigmal vein, forms a densely pigmented **stigmal spot** (ss) or pseudostigma. Traces of other veins are present in some species and are represented by spectral or infusate lines. These vary from being transparent and very difficult to see to faintly pigmented. **Microtrichia** are present on all wing surfaces but may be sparser or absent basally. The hind wing has two **frenal hooks** (hamuli) which lock into the slightly sclerotised frenal groove on the fore wing. The fore wing has a short, fine **marginal fringe** in the apical part. The hind wing has a long, fine marginal fringe posteriorly, which is longest basally and gradually becomes shorter towards the apex of the wing.

To interpret the homology of the spectral veins sometimes present in the wings of *Scelio* species, it is necessary to briefly examine the venation of scelionid genera that possess more complete venational patterns, viz. the extant genera *Archaeoteleia* Masner (Fig. 5.18) and *Neuroscelio* Dodd (Fig. 5.21), and the fossil genus *Brachyscelio* Brues (Figs 5.22, 5.23). The fore wing of *Archaeoteleia* shows the most complete venation with R1 and 1Rs represented by tubular veins (in addition to Sc+R and r), M+Cu, Rs+M, 2Rs, M, Cu and m-cu represented



Figs 5.21–5.23. Wings: 5.21. Fore and hind wings of *Neuroscelio nervalis* Dodd. 5.22. Fore wing of *Brachyscelio cephalotes* Brues. 5.23. Fore wing of *Brachyscelio dubius* Brues.

by infusate lines. The hind wing is also relatively complete and shows traces of R, r-m and Rs+r, in addition to the distal part of Sc+R. The venation of *Neuroscelio* is slightly reduced in comparison with *Archaeoteleia* in that m-cu is missing, Cu is broken medially in the fore wing, and Rs+r is missing from the hind wing. In these genera, the second abscissa of Rs+M is never present so that the submarginal cell (bounded distally by r and Rs) is always open.

The fossil genus *Brachyscelio*, known from Oligocene Baltic amber (Brues 1940), has similar complete venation which differs markedly between the two described species. The fore wing of *B. dubius* Brues (Fig. 5.23) has the second submarginal cell closed posteriorly by the infusate veins 2Rs+M and m-cu, while M+Cu, 1Rs+M (basal vein) and Cu are either tubular or very strongly pigmented. However, in *B. cephalotes* Brues (Fig. 5.22) Sc+R (submarginal) and R1 are distant from the wing margin and 2Rs+M and m-cu are missing, so that the distal venation is somewhat similar to that of *Neuroscelio* (Fig. 5.21).

Several species of *Scelio* show faint traces of veins in the fore wing other than the submarginal, marginal and stigmal veins. *S. miki* sp. nov. and *S. petilus* sp. nov. (Figs 5.19, 5.20) have Rs and M present and indicated by infusate lines, while M+Cu and sometimes Cu are represented by a faintly transparent spectral line. The basal part of the fore wing in *S. miki* is largely glabrous and has three connected setal lines, but these do not appear to be homologous to any veins.

METASOMA

The sculpturing of the metasoma varies from being heavily sculptured (see Fig. 8.99) to mostly smooth (see Fig. 8.54). Sculpturing patterns can be difficult to describe at species level as there may be substantial interspecific variability. The shape of the **first metasomal tergite** (T1) is variable, but anteriorly it has an upper section and a lower section (Figs 5.1, 5.8). The width of the upper section (T1uW) is less than or equal to the width of the lower section (T1lW). The length of T1 (T1L) also varies substantially from being equal to T1uW to half of T1uW. The **second tergite** (T2) has **lateral ridges** (lr; Fig. 5.1) which vary in height and definition, and extend longitudinally for about two-thirds the length of the tergite. The **second metasomal sternite** (S2) has a **basal transverse ridge** (tr) with an anterior furrow which may vary in height. S2 and S3 sometimes have lateral **felt fields** (ff) present medio-laterally (Fig. 5.2).

FEMALE GENITALIA AND OVIPOSITOR SYSTEM

The **genitalia** of female Hymenoptera is modified into a valvular **ovipositor** (Figs 5.31, 5.36), which is derived from paired ventral outgrowths of abdominal segments 8 and 9 (see Austin 1983). With the exception of aculeate wasps, which have the ovipositor developed

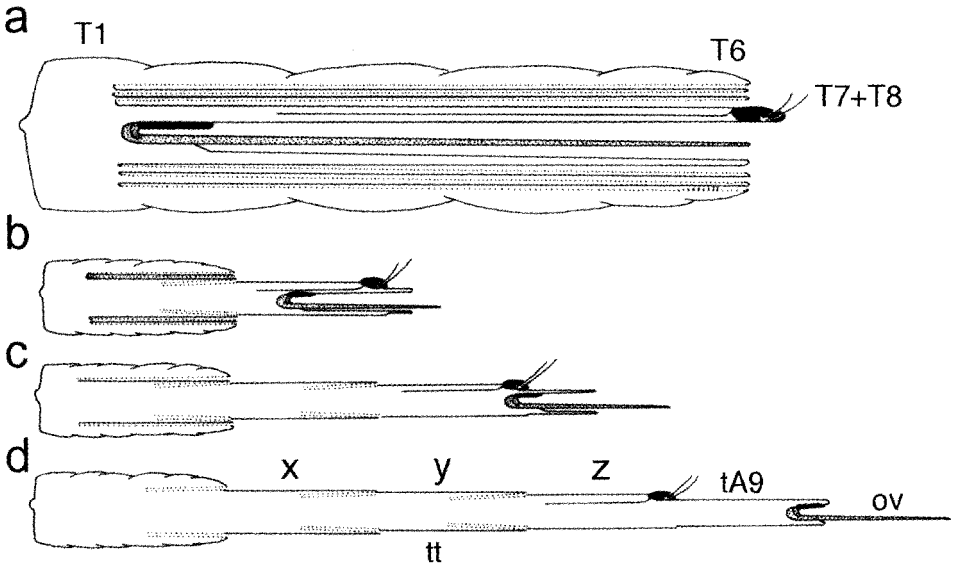
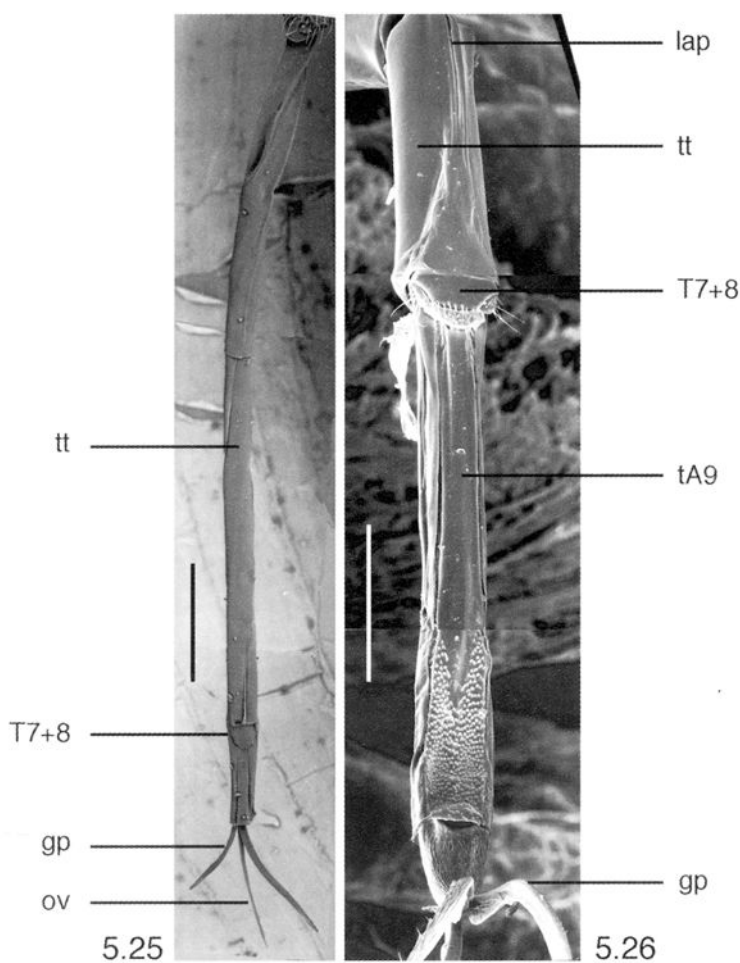
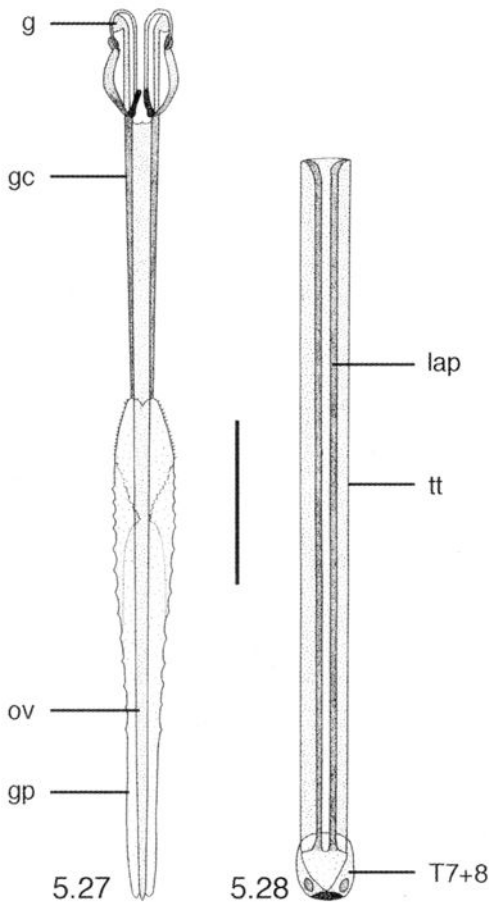


Fig. 5.24. Extension of the ovipositor system in *Scelio*: **a.** fully retracted into metasoma, **b.** first stage of telescopic tube extension, **c.** second stage of telescopic tube extension, **d.** ovipositor system fully extended, x, y and z indicating three sections of telescopic tube (see Table 5.1 for abbreviations) (drawings not to scale; after Field & Austin 1994).



Figs 5.25, 5.26. Extension of the ovipositor system in *S. fulgidus* Crawford:
5.25. Telescopic tube nearly fully extended. **5.26.** Telescopic tube partly
extended. Scale lines: 5.25, 0.4 mm; 5.26, 0.2 mm.

into a sting, this structure acts as a device for egg laying and to introduce a fluid into the oviposition site. In the case of parasitic species, the oviposition fluid comprises a complex mixture of mostly proteaceous components that variously act as (1) a lubricant for the egg travelling down the ovipositor shaft, (2) a venom that causes either short-term or permanent paralysis of the host, or (3) an agent to modify the internal physiology of the host (Gauld & Bolton 1996; Quicke 1997). For scelionids, the oviposition fluid probably acts as a lubricant and to modify the internal environment of the host (e.g. Strand 1986), but not as a venom in the strict sense given that host eggs are immobile and largely undeveloped. Like other parasitic wasps, the elongate ovipositor of scelionids operates as a 'linear ratchet' at the time of oviposition. The valves or gonopophyses that comprise the **ovipositor** (ov) shaft are locked together by a tongue and groove arrangement which stops them from pulling apart, but allows them to slide backwards and forwards relative to each other (Austin 1983; Quicke

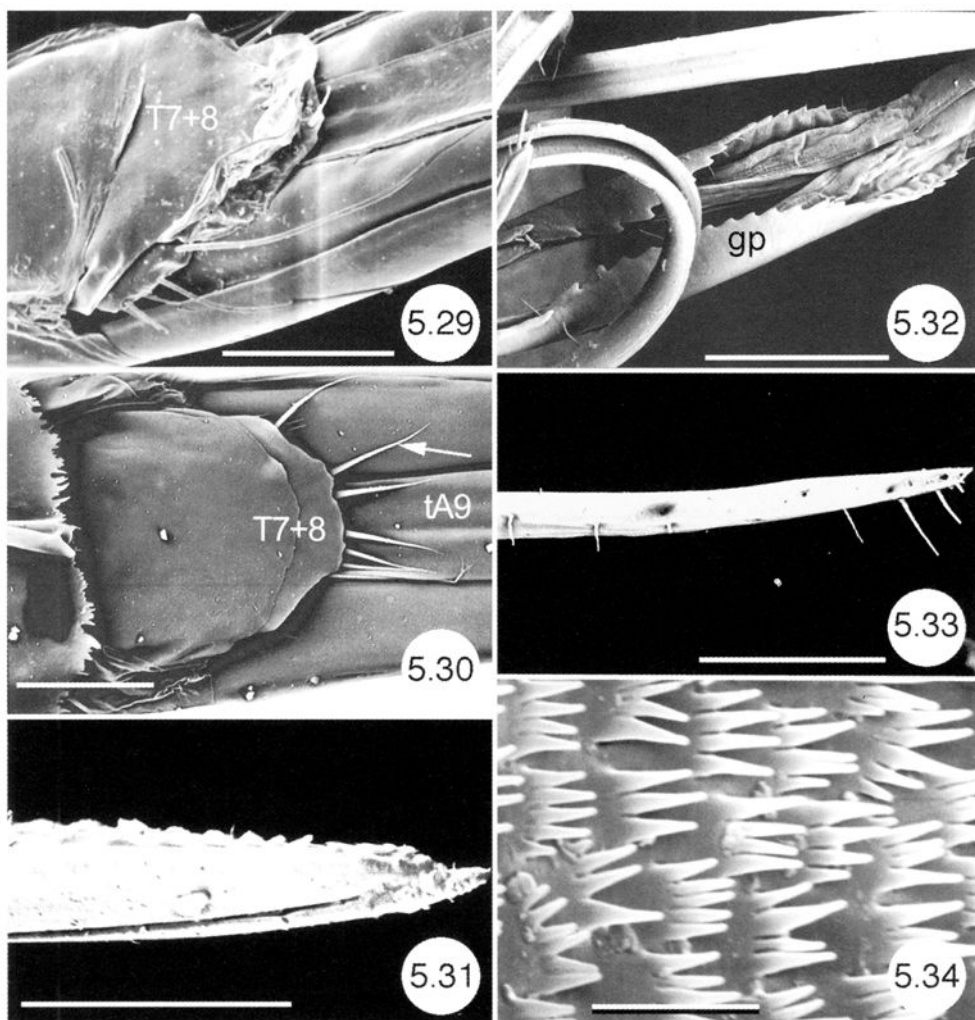


Figs 5.27, 5.28. Ovipositor system of *S. fulgidus* Crawford: **5.27.** Ovipositor assembly. **5.28.** Unextended telescopic tube with tergites 7+8 (after Austin & Field 1997). Scale line 0.25 mm.

et al. 1994). This movement is created by antagonistic muscles attached to the proximal end of the valves. Posteriorly oriented teeth or spines on the inside surface of the valves (Fig. 5.34) catch the surface of the egg and pull it down the length of the ovipositor (like a linear ratchet), as the valves move backwards and forwards (Austin & Browning 1981). This movement also provides the means for the serrated tip of the valves to cut into the oviposition site which, in the case of scelionid wasps, is the chorion of their host eggs.

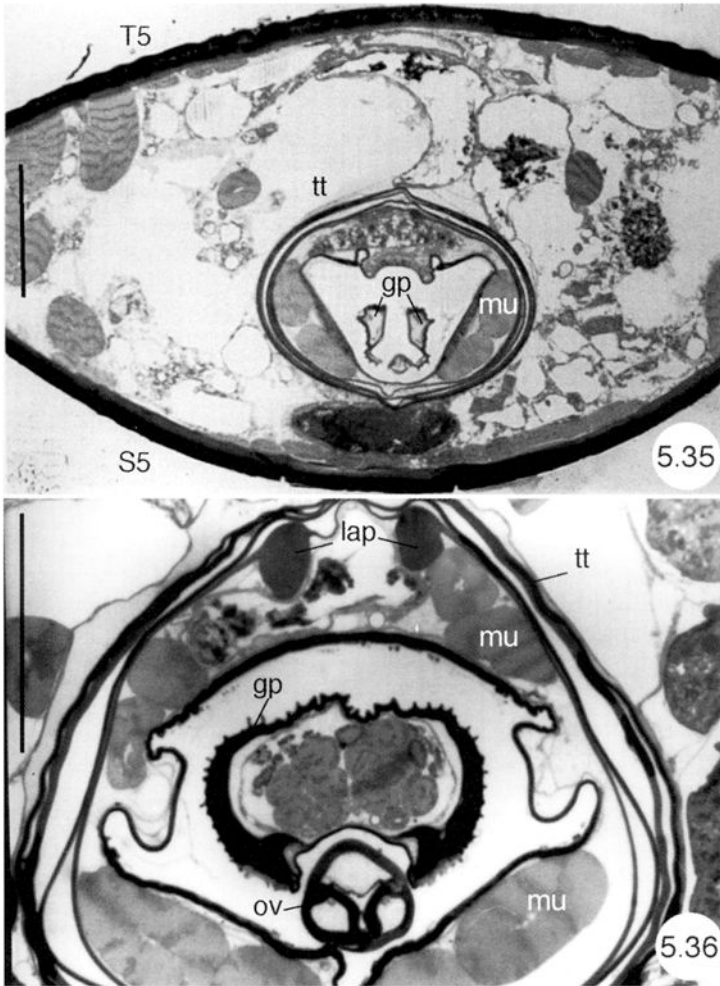
Associated with the ovipositor is a pair of **gonoplasts** (gp) or ovipositor sheaths (Figs 5.27, 5.33). These are posterior outgrowths of the **gonocoxae** (gc) which surround and protect the ovipositor. A number of different types of **sensilla** are located at their distal end, including long hair sensilla (Fig. 5.33), which are undoubtedly involved in host location/acceptance. Sensilla of metasomal tergite 7+8 may also be involved in this process (Figs 5.29, 5.30). The gonoplasts of *Scelio* are generally more robust than those of other scelionid genera, and are serrate along their basal margins (Figs. 5.32).

The ovipositor of the Platygastroidea (Scelionidae + Platygastriidae) differs from that of all other Hymenoptera in that it is retracted into the metasoma via the elongation and desclerotisation of **abdominal segment 9** (referred to as tubular A9) (Austin & Field 1997).



Figs 5.29–5.34. 5.29. Dorso-lateral view of tergite 7+8 of *Scelio* sp. showing sensilla (after Field and Austin 1994). 5.30. Dorsal view of tergite 7+8 of *Scelio* sp. showing sensilla (arrowed) (after Field and Austin 1994). 5.31. Distal end of ovipositor shaft of *S. fulgidus* Crawford showing separation of valves. 5.32. Proximal end of gonoplace of *S. fulgidus* showing serrated margins. 5.33. Distal end of gonoplace of *S. fulgidus* showing long hair sensilla. 5.34. Inner surface of ovipositor valve of *S. fulgidus* showing posteriorly directed teeth (after Field and Austin 1994). Scale lines: 5.29, 5.30, 40 μ m; 5.31, 20 μ m; 5.32, 5.33, 0.1 mm; 5.34, 10 μ m.

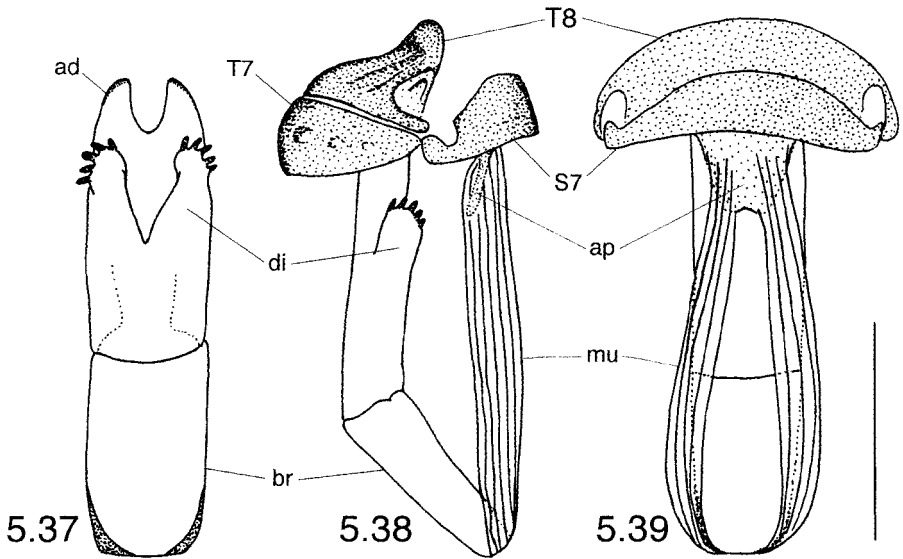
Also, the ventral valves of the ovipositor shaft are strongly overlapping, i.e. partly wrapped around each other (Quicke *et al.* 1994). At rest the ovipositor is wholly contained within the metasoma, an adaptation which probably protects the fine hypodermic-like ovipositor from damage when it is not being used. This arrangement was first described for the genus *Ceratobaeus* Ashmead and is characterised by a system of antagonistic muscles attached to elongate apodemes which are responsible for extension and retraction of the ovipositor (Austin 1983; Austin & Field 1997). A further modification to the ovipositor system was latter described in detail for the genus *Scelio* and related genera, where the ovipositor is extended from the metasoma at the end of an elongate, eversible, **telescopic tube** (tt) (Figs 5.24–5.26,



Figs 5.35, 5.36. Histological sections showing the ovipositor system of *S. fulgidus* Crawford: **5.35.** Transverse section through metasoma showing sections of retracted telescopic tube. **5.36.** Transverse section through retracted telescopic tube showing 4 sections of tube and ovipositor (after Austin & Field 1997). Scale lines: 5.35, 70 μm ; 5.36, 40 μm .

5.35, 5.36). The structure and functioning of this system, although mentioned briefly in previous taxonomic publications (e.g. Masner 1976b), was described fully by Field and Austin (1994). The telescopic tube is homologous to the intersegmental membrane between abdominal segments 7 and 8 (metasomal segments 6 and 7+8, the latter being fused in scelionids), which is greatly elongated and forms a tubular structure. Using histological studies and fine dissections, in parallel with behavioural observations, Field and Austin (1994) were able to show that the telescopic tube is extended and retracted by changes in hydrostatic pressure, probably mediated by tergal-sternal muscles which contract to squeeze the metasoma and increase the pressure in the haemocoel.

Comparative studies on the majority of scelionid genera show that the *Ceratobacus*-type system is plesiomorphic, and that the *Scelio*-type has evolved from it. The latter type of



Figs 5.37–5.39. Generalised male genitalia of *Scelio*: 5.37. Aedeagus. 5.38. Lateral view of aedeagus and tergites 7 & 8. 5.39. Ventral view of tergite 8, sternite 7 and aedeagal muscle. Scale line 0.25 mm.

ovipositor system defines a large monophyletic group containing approximately 50 scelionid genera (Austin & Field 1997). Host records indicate that this group is specifically associated with orthopteran hosts and, in the case of *Scelio* and its relatives (i.e. the Scelionini *s. str.*), with the Acrididae. The development of the *Scelio*-type system involved a major functional change from an ovipositor extended and retracted from the metasoma by muscles (*Ceratobaeus*-type) to one that primarily utilises hydrostatic pressure. Coincident with this change, the elongate **lateral apodemes** (lap) in the *Ceratobaeus*-type, which act as attachment points for retractor muscles, have migrated and become incorporated into the cuticular wall of the telescopic tube (Figs 5.26, 5.28, 5.36), and the associated muscles have subsequently been lost. The function of the apodemes has therefore changed between the two systems, from points of muscle attachment to rods that strengthen the walls of the telescopic tube.

Compared with the *Ceratobaeus*-type in which the ovipositor can only be as long as the metasoma, the telescopic tube of the *Scelio* system allows the ovipositor to be extended from the body to a length up to 3.5 times that of the metasoma, depending on the number of telescopic elements that make up the tube. These vary from two or three in various *Scelio* species to four or more in some genera of *Calliscelio*, *Anteromorpha*, *Duta* and *Harringtonia* (Field & Austin 1994; Austin & Field 1997). Observations on *S. fulgidus* show that the telescopic tube is used to reach down and oviposit into eggs that would otherwise be inaccessible in the bottom half of egg pods buried in soil (Field & Austin 1994).

MALE GENITALIA

The **male genitalia** (Figs 5.37–5.39) is simple and consists of a **basal ring** (br), **aedeagus** (ad) and **volsella** in the form of a toothed **digitus** (di). Tergite 8 is attached to T7 and has a hinged joint with sternite 7. An elongate **apodeme** (ap) on S7 attaches **muscles** (mu) to the basal ring of the aedeagus, which enables the aedeagus to extend through the hinged opening between T7+8 and S7.

CHAPTER 6

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Phylogeny

This chapter outlines the procedures used for the phylogenetic analysis and presents the results of preliminary analyses undertaken to explore the relationships among Australian *Scelio* species. Characters important at species level are discussed with respect to their performance in the analyses.

MORPHOMETRIC DATA

Morphometric data are continuous and need to be assigned discrete states so that they may be incorporated into a phylogenetic analysis. The method used to assign states to the morphometric data was modified from the segment coding procedure outlined by Chappill (1989), in which a segment is a range of values which becomes a state for the character. For this, the ranges for each measurement were used rather than the means, and segments were assigned as 1 SD ranges from the minimum value. Those characters that varied by less than five SD were treated as polymorphisms. If a character for a particular taxon had an overlap of five SD or greater then it was considered to be too variable and was not used in the analysis. The following characters were excluded on these grounds: the ratio of ocellar diameter to length between eyes, the ratio of the length of malar space to height of eye, and the ratio of the propodeum medial length to anterior width.

PHYLOGENETIC METHODS

The program Phylogenetic Analysis Using Parsimony (PAUP*) 4.0d64 beta test version (Swofford 1998) was used for all parsimony-based phylogenetic analyses. MacClade 3.07 (Maddison & Maddison 1992) was used to input data and to trace characters on the resultant trees.

The following heuristic search analysis parameters were invoked for PAUP*: HOLD 10, MULPARS, ACCTRAN. Searches were carried out using 200 random-addition replicates, with 10 trees held at each addition in order to minimise the effects of ties early in the process (Swofford & Begle 1993); TBR branch swapping was performed with maxtrees effectively unlimited. Characters were treated as unordered and unpolarised, with polarities determined *a posteriori* by outgroup rooting of trees (Farris 1972; Maddison *et al.* 1984; Swofford & Begle 1993). The consistency index (CI) was used as the measure of fit of characters to the tree (Kluge and Farris 1969). The retention index (RI) gives the fraction of apparent synapomorphy for the characters that are retained as such on the tree (Farris 1989). As both CI and RI are sensitive to the number of characters in the analysis (Farris 1989), the total support index (TI) (K. Bremer 1994; B. Bremer 1996) was used as a measure of tree stability in terms of supported resolution as it is not correlated with the number of characters. Strict consensus trees were obtained in order to assess common topologies for multiple equally parsimonious cladograms (Anderberg & Tehler 1990). Bootstrap analyses were conducted to assess the confidence of each node (Efron 1979, 1982, 1987; Felsenstein 1985; Hillis & Bull 1993). Bremer support or decay indices (Bremer 1988, 1994) were calculated to indicate the strength of particular nodes. Trees were weighted *a posteriori* using the successive approximations approach (Farris 1969, Carpenter 1988) in order to focus on the most consistent characters in the data set. Additive binary coding was used to avoid overweighting

of multistate characters (Carpenter 1988), and weights were calculated using the rescaled consistency index (RC) (Farris 1989).

SELECTION OF TAXA

Due to uncertainty about the monophyly of *Scelio*, the ingroup was considered as the tribe Scelionini *s. str.* Ingroup taxa included all *Scelio* species from the Australian region for which females were known, as well as exemplar taxa from the genera *Acanthoscelio* Ashmead, *Dicroscelio* Kieffer, *Heptascelio* Kieffer, *Lepidoscelio* Kieffer, *Oreiscelio* Kieffer and *Sceliocerdo* Muesebeck. Potential outgroups were selected from the Scelionidae, including *Psilanteris* Kieffer, *Sceliomorpha* Ashmead, *Sparasion* L., *Archaeoteleia* Masner and the fossil genus *Archaeoscelio* Brues. After careful consideration, *Archaeoteleia mellea* Masner was subsequently chosen as the most likely outgroup as it is, putatively, the most primitive member of the Scelionini *s. l.*, a group defined by having a 'Scelio-type' ovipositor (Austin & Field 1997).

PHYLOGENETIC CHARACTERS

Many sculpturing characters, particularly on the head and metasoma, were examined but rejected as potentially informative because of the difficulty in coding them into discrete states.

QUALITATIVE CHARACTERS

1. Pilosity over body fine (0), coarse in part (Figs 8.193, 8.213) (1).
2. Colour of scutum black/brown (0), with some orange/yellow (1).
3. Colour of coxae black/brown (0), with some orange/yellow (1).
4. Male antennal segment 5 with tyloids (Figs 5.9–5.13) (0), without tyloids (1).
5. Male antennal segment number 14 (0), 12 (1), 10 (2).
6. Base of mandible smooth (Fig. 8.36) (0), with reticulate sculpturing (Fig. 8.19) (1).
7. Mandible with dorsal tooth absent (Fig. 8.61) (0), present (Fig. 8.194) (1).
8. Number of apical mandibular teeth 3 (0), 2 (1), 1 (2).
9. Frontal carina present (0), absent (1).
10. Occipital carina complete (0), absent dorsally (1).
11. Malar region with radiating striae (Figs 8.134, 8.175) (0), reticulate punctation (Fig. 8.28) (1), punctate (Fig. 8.86) (2).
12. Interantennal process with lateral carinae not continuing onto speculum (Fig. 8.88) (0), continuing onto speculum (Figs 8.12, 8.14, 8.151) (1).
13. Speculum defined and smooth (0), not defined, sculptured (1).
14. Clypeal margin between lateral points evenly convex (Fig. 8.211) (0), straight medially (Fig. 8.213) (1), concave medially (Fig. 8.207) (2).
15. Notauli clearly defined (0), poorly defined amongst surrounding sculpturing (1), absent (2).
16. Dorso-lateral pronotum with transverse carina present (Fig. 8.158) (0), absent (Fig. 8.160) (1).
17. Latero-ventral pronotum sculptured anteriorly (0), smooth anteriorly (1).
18. Anterior scutum evenly sculptured (Fig. 8.57) (0), sculpturing reduced or smooth (Figs 8.54, 8.131) (1).
19. Medial scutum sculpturing without longitudinal trend (Fig. 8.148) (0), with longitudinal trend (Fig. 8.141) (1).

20. Scutellum with lateral nodes absent (Fig. 8.229) (0), present (Fig. 8.227) (1).
21. Dorsellum only slightly raised above lateral metanotum (Fig. 8.81) (0), moderately raised (Figs 8.41, 8.107) (1), prominent (Figs 8.94, 8.95) (2).
22. Dorsellum with medial spine (0) not emarginate medially (1), slightly emarginate (2), deeply emarginate (Fig. 8.125) (3).
23. Netrion well developed and distinct (0), defined with anterior furrow but obscured by sculpturing (1), not defined (2).
24. Mesopleuron striate (0), punctate (1).
25. Mesosternum smooth (0), with sparse fine punctation (1), densely sculptured (2).
26. Stigmal spot defined (Figs 5.19, 5.20) (0), not defined (Fig. 5.23) (1).
27. Stigmal apical vein (r) tubular (Fig. 5.19) (0), either infusate, spectral (Fig. 5.20) or absent (1).
28. Submarginal vein of fore wing tubular (0), spectral (Fig. 5.20) (1).
29. Rs of fore wing tubular/infusate (0), spectral/absent (1).
30. Submarginal vein of hind wing tubular throughout (0), tubular in basal half (1), spectral/infusate basally (2).
31. Fore leg trochantellus present (0), absent (1).
32. Propodeum with indentation about nucha (Fig. 5.1) (0), without indentation (1).
33. Propodeum with latero-ventral corners square (Fig. 5.1) (0), pointed (1), rounded (2).
34. Propodeum with percurrent medial longitudinal furrow (Fig. 5.1) (0), furrow either present in anterior half or not defined (1).
35. S2 with basal transverse ridge present (Figs 5.2, 8.109) (0), absent (1).
36. S2 felt fields present (Fig. 5.2) (0), absent (1).
37. S3 felt fields present (Fig. 5.2) (0), absent (1).

QUANTITATIVE OR MORPHOMETRIC CHARACTERS

38. Body length (mm) 2.6–3.13 (0), 3.14–3.73 (1), 3.74–4.30 (2), 4.31–4.87 (3), ≥ 4.88 (4).
39. Ratio of OOL to POL (Fig. 5.1) 0.02–0.07 (0), 0.08–0.13 (1), 0.14–0.20 (2), 0.21–0.26 (3), 0.27–0.31 (4), ≥ 0.32 (5).
40. Ratio of lower apical mandibular tooth length to upper apical mandibular tooth length (Fig. 5.3) 0–0.41 (0), 0.42–0.83 (1), 0.84–1.05 (2), 1.06–1.47 (3), ≥ 1.48 (4).
41. Metasomal length/width (Fig. 5.1) 1.69–2.0 (0), 2.01–2.32 (1), 2.33–2.64 (2), 2.65–2.97 (3), 2.98–3.29 (4), ≥ 3.30 (5).
42. T1 lower anterior width/medial length (Fig. 5.8) 0.2–0.39 (0), 0.4–0.59 (1), 0.6–0.79 (2), 0.8–0.99 (3), 1.0–1.19 (4).
43. T1 lower anterior width/upper anterior width (Figs 5.8, 8.43) 1.0–1.20 (0), 1.21–1.41 (1), 1.42–1.62 (2), 1.63–1.83 (3), 1.84–2.04 (4), ≥ 2.05 (5).

RESULTS AND DISCUSSION

The matrix (Table 6.1) of 64 taxa by 43 characters does not provide enough information for the relationships among taxa to be completely resolved. This is supported by a skewness *g*₁ statistic of -0.2 (Huelsenbeck 1991). The results of analyses conducted should therefore be considered as preliminary.

Two hundred random addition sequence replicates found 7115 equally parsimonious trees of 553 steps in a single island hit 26 times, with CI of 0.33, RI of 0.30, and TI of 0.16. The CI of 0.33 is low, but within the standard error of the 0.36 predicted for 64 taxa by regression

Table 6.1. Data matrix of 64 taxa by 43 characters used in the cladistic analysis. Numbers underlined indicate polymorphic coding. "?" indicates missing data.

	1	2	3	4	5	6	7	8	9	0	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	4	4	4	4			
	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3		
<i>Archeotelecia mellea</i>	0	0	0	0	1	0	0	0	1	0	0	0	1	1	0	0	1	0	0	1	0	1	2	0	0	0	0	0	0	1	0	1	1	0	1	1	3	5	2	5	4	2			
<i>Acanthoscelio</i>	0	1	1	1	1	1	0	1	0	0	2	0	0	2	2	1	1	0	0	1	2	0	0	0	2	1	1	1	1	1	0	0	1	1	1	0	3	0	?	1	1	5			
<i>Dicroscelio</i>	0	1	1	1	1	1	0	0	1	0	0	0	1	2	0	1	0	0	0	0	2	3	1	1	2	0	0	0	1	1	0	0	1	1	1	1	1	1	0	?	0	1	4		
<i>Heptascelio</i>	0	0	0	1	1	0	0	0	1	0	2	1	1	0	2	1	0	0	1	1	2	0	0	1	2	0	0	0	1	1	1	0	1	1	0	0	3	3	3	2	2	4			
<i>Lepidoscelio</i>	0	1	1	0	2	1	0	1	1	0	0	0	0	2	2	0	1	0	0	0	2	3	1	1	2	0	0	0	1	1	1	0	0	1	0	1	1	3	1	1	2	1	2		
<i>Oreiscelio</i>	0	0	0	1	1	0	0	1	1	0	2	0	0	2	2	1	1	0	1	0	2	2	0	0	2	0	0	0	1	1	1	0	1	1	1	1	1	0	2	2	0	0	3		
<i>Scelioacero</i>	0	0	1	0	2	0	0	1	0	1	0	1	1	?	1	0	0	0	1	0	2	3	2	0	2	0	1	0	1	1	1	0	0	1	1	1	3	1	?	2	1	1			
<i>Scelio amoenus</i>	0	0	1	?	?	?	0	0	1	1	1	0	0	0	1	1	0	1	0	0	2	2	1	1	1	0	0	0	1	2	1	0	0	0	0	0	0	45	13	0	12	01	01		
<i>S. anmarae</i>	0	0	1	?	?	?	0	0	1	1	1	0	0	0	0	1	1	1	0	0	2	3	1	0	0	0	1	1	1	1	1	0	1	0	0	01	1	1	1	3	1	1	0	01	
<i>S. annae</i>	0	0	1	?	?	?	0	0	1	1	0	0	0	0	2	1	0	0	0	0	2	1	1	1	1	0	1	0	1	1	1	0	0	1	0	0	1	45	1	1	23	1	01		
<i>S. anyirambo</i>	0	0	1	?	?	?	0	0	1	1	1	0	0	0	2	0	0	1	1	0	0	2	1	1	1	1	1	0	1	1	1	0	0	0	0	0	0	23	2	2	0	01	0		
<i>S. asperatus</i>	0	0	1	0	2	1	0	1	1	1	0	1	0	1	1	1	0	1	0	0	2	1	1	0	2	0	0	0	1	2	1	1	0	1	0	0	0	345	12	01	234	123	0		
<i>S. borroloolensis</i>	1	0	1	?	?	?	0	1	1	1	1	0	0	0	1	1	0	1	0	0	2	2	0	1	2	0	0	0	1	1	1	1	2	1	0	0	0	4	0	2	1	1	0		
<i>S. bronei</i>	0	1	1	?	?	?	0	0	1	1	1	1	0	0	0	1	1	1	0	0	2	12	1	1	1	0	0	0	1	1	1	0	0	0	0	0	1	12	2	2	1	0			
<i>S. chortoiectes</i>	0	0	01	1	2	0	0	2	1	1	2	0	0	2	0	0	1	1	0	0	0	1	1	0	0	01	1	1	1	2	1	1	0	1	1	1	1	23	0	0	01	0	01		
<i>S. concinnus</i>	0	1	1	?	?	?	0	0	1	1	0	0	0	0	12	0	1	0	1	0	0	2	3	1	0	0	0	1	1	1	2	1	0	1	0	1	1	1	1	1	2	0	0	13	
<i>S. contractus</i>	1	0	01	?	?	?	0	0	1	1	1	2	0	0	01	0	0	1	0	0	0	2	3	1	0	0	1	0	1	1	1	2	1	0	0	0	0	1	23	01	12	01	0	1	
<i>S. cruentatus</i>	0	1	1	?	?	?	0	0	1	1	1	2	0	0	0	1	0	0	0	0	0	1	2	1	0	0	0	1	1	1	2	1	0	2	0	0	1	1	3	0	2	2	0	1	
<i>S. diemenensis</i>	0	0	0	?	?	?	0	0	1	1	0	0	0	0	01	1	0	1	0	0	0	0	1	1	1	2	?	?	?	?	?	?	1	0	0	0	0	1	1	23	2	2	2	2	0
<i>S. doddi</i>	0	1	1	?	?	?	0	0	1	1	1	0	0	0	2	1	0	1	1	0	0	2	2	1	1	2	0	0	1	1	2	1	0	0	1	0	0	1	2	1	2	1	0	1	
<i>S. erythropus</i>	0	1	1	?	?	?	0	0	1	1	0	0	0	0	01	1	0	1	0	0	0	0	1	1	1	?	?	0	1	1	1	2	1	0	02	1	0	0	1	4	1	1	3	2	0
<i>S. flavigaster</i>	0	0	1	?	?	?	0	0	1	1	1	0	0	0	0	2	0	1	0	0	0	2	2	1	1	1	0	1	1	1	2	1	0	0	0	0	0	1	23	12	2	01	0	01	
<i>S. fulgidus</i>	0	0	01	0	2	0	0	1	1	0	2	0	0	0	0	0	0	1	1	0	0	0	1	1	1	0	1	1	1	2	1	1	2	0	0	0	1	1	3	0	0	1	2	0	
<i>S. fulvithorax</i>	0	1	1	?	?	?	0	0	1	1	1	2	0	0	1	1	0	1	1	1	0	2	3	1	0	1	0	1	1	1	2	1	0	0	0	0	1	1	34	01	2	12	0	12	
<i>S. gallowayi</i>	0	1	1	?	?	?	0	0	1	1	1	0	0	0	0	1	0	1	0	0	0	2	12	1	1	2	0	1	1	1	2	1	0	0	0	0	0	0	23	23	2	12	0	1	
<i>S. gobar</i>	1	0	01	0	2	0	0	1	1	0	01	0	0	0	1	0	0	0	0	0	0	1	1	1	2	0	0	0	1	2	1	0	01	1	0	0	0	345	12	1	234	12	0		
<i>S. grbini</i>	0	1	1	?	?	?	0	0	1	1	0	0	0	0	1	1	0	0	0	0	2	1	1	1	1	0	1	0	1	2	1	0	02	0	0	0	0	34	0	2	2	1	0		
<i>S. ignobilis</i>	0	0	1	1	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0	1	2	1	1	2	0	0	0	1	23	12	1	1	23	0		
<i>S. improcerus</i>	0	0	0	?	?	?	0	0	1	1	0	2	0	0	0	0	1	1	0	0	0	2	3	1	0	1	0	1	1	1	2	1	0	2	0	0	1	1	23	12	1	12	0	1	
<i>S. jokentae</i>	0	0	0	?	?	?	0	0	1	1	1	2	0	0	0	1	0	1	0	0	0	2	3	1	0	2	0	1	1	1	2	1	0	0	0	0	1	1	4	1	1	2	0	2	
<i>S. juni</i>	1	1	1	?	?	?	0	0	1	1	1	1	0	0	1	1	0	1	0	0	0	2	2	1	1	2	0	1	1	1	2	1	0	0	1	1	0	0	3	3	2	01	0	1	
<i>S. littoralis</i>	0	0	1	?	?	?	1	0	1	1	0	0	1	0	1	0	0	1	1	0	0	2	1	1	0	2	0	0	0	1	2	1	0	1	0	0	0	1	4	1	1	2	2	0	
<i>S. locustae</i>	1	0	0	1	2	0	1	1	1	1	0	0	0	2	2	0	1	0	0	0	2	1	1	1	2	0	1	1	1	2	1	1	2	0	0	0	0	34	01	1	2	2	01		
<i>S. mareebaensis</i>	0	0	1	?	?	?	0	0	1	1	0	0	0	0	0	1	0	1	0	1	0	2	23	1	01	2	0	1	1	1	2	1	0	02	0	0	0	0	4	1	4	2	1	12	
<i>S. matthewsi</i>	0	0	1	?	?	?	0	0	1	1	1	0	0	0	1	0	0	1	0	0	0	0	1	2	0	2	0	0	0	1	2	1	0	2	0	0	0	1	4	12	1	23	2	0	
<i>S. meridionalis</i>	0	0	0	0	2	0	0	1	1	0	0	0	0	01	0	0	1	0	1	0	1	0	1	1	1	0	0	0	1	2	1	0	0	0	0	1	1	4	1	1	12	12	0		
<i>S. miki</i>	1	0	01	0	2	1	0	1	1	0	0	0	0	01	1	1	0	0	0	0	0	1	1	1	1	1	0	0	0	1	1	1	0	2	0	0	0	0	5	1	1	23	1	01	

Table 6.1. continued

	1	2	3	4	5	6	7	8	9	0	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	4	4	4	4				
	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	
<i>S. nanocuspis</i>	0	0	1	?	?	0	0	1	1	1	0	1	0	1	1	0	1	0	0	0	2	12	1	0	2	0	0	0	1	2	1	1	0	1	1	1	1	45	1	0	1	0	23	
<i>S. naumanni</i>	0	0	1	?	?	0	0	1	1	1	0	0	0	2	1	0	1	0	0	0	2	3	1	1	2	0	0	0	1	2	1	0	0	0	1	0	0	34	1	1	1	0	1	
<i>S. nigriscutellum</i>	0	1	1	?	?	0	0	1	1	1	01	0	0	0	0	0	1	1	0	0	2	3	1	1	1	0	1	1	2	1	0	0	0	0	1	1	123	12	12	1	0	0		
<i>S. nigrobrunneus</i>	0	0	1	?	?	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	2	1	0	0	1	0	1	1	4	1	1	1	0	2	
<i>S. notabilis</i>	0	0	1	?	?	0	0	1	1	0	0	0	0	1	0	0	1	0	1	0	2	2	1	1	2	0	1	1	1	2	1	0	0	1	0	0	0	3	12	1	12	0	01	
<i>S. orientalis</i>	0	0	1	0	2	1	0	1	1	0	0	0	0	01	0	0	0	01	0	0	2	1	1	1	2	0	0	0	1	2	1	1	01	0	0	0	0	3	23	1	12	3	0	
<i>S. parvicornis</i>	0	0	0	0	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	01	1	0	1	0	1	2	1	0	0	0	0	0	1	23	01	0	12	1	01	
<i>S. pambertoni</i>	0	0	1	0	2	0	0	1	1	0	1	0	0	0	1	0	1	0	0	1	1	2	1	1	2	0	0	0	0	1	1	0	0	1	0	0	0	3	3	1	3	1	0	
<i>S. perspicuus</i>	0	0	1	?	?	0	0	1	1	0	0	0	0	2	1	0	1	1	0	0	2	12	1	1	2	0	1	1	1	2	1	0	0	1	0	0	0	34	01	1	12	1	12	
<i>S. petilus</i>	0	0	0	?	?	0	0	1	1	1	2	0	0	1	2	0	0	0	0	0	0	1	2	1	1	0	1	1	1	2	1	0	1	0	0	0	0	23	2	1	3	2	0	
<i>S. pigotti</i>	1	0	0	?	?	0	0	1	1	1	2	0	0	01	0	01	1	0	0	0	2	3	1	0	1	0	1	1	1	2	1	0	0	0	0	1	1	3	1	2	1	0	12	
<i>S. pilosifrons</i>	1	0	1	?	?	0	0	1	1	1	2	0	0	0	0	0	1	0	0	0	2	2	1	0	0	0	1	1	1	2	1	0	0	0	0	1	1	23	0	4	1	0	1	
<i>S. pilosus</i>	1	0	0	?	?	0	1	1	1	1	0	0	0	1	2	0	1	0	0	0	1	1	1	0	2	0	0	0	1	2	1	1	2	1	0	0	0	2	0	2	2	12	0	
<i>S. planithorax</i>	0	0	1	?	?	0	0	1	1	1	01	0	0	1	0	0	0	0	0	0	0	1	1	1	0	1	0	1	0	1	2	1	1	0	0	0	1	1	4	01	12	2	2	0
<i>S. pseudaustralis</i>	1	0	1	?	?	0	0	1	1	1	0	0	0	0	1	0	0	0	0	0	1	1	1	1	2	0	0	0	1	2	1	0	0	0	0	0	0	34	1	1	3	2	0	
<i>S. punctaticeps</i>	0	0	1	?	?	0	0	1	1	0	1	0	0	0	2	0	1	0	0	0	0	1	2	1	2	0	0	0	1	2	1	0	2	1	0	1	1	23	234	12	23	23	0	
<i>S. reticulatum</i>	1	1	1	?	?	0	0	1	1	1	2	0	0	0	1	0	1	1	0	0	2	2	1	0	0	0	1	1	1	2	1	0	02	0	0	1	1	4	0	12	2	0	2	
<i>S. schmelio</i>	0	1	0	?	?	0	0	1	1	0	0	0	0	12	2	0	1	0	0	0	2	1	1	0	2	0	1	1	1	2	1	0	2	1	0	0	0	34	01	1	1	1	1	
<i>S. semisanguineus</i>	1	01	1	?	?	0	0	1	1	1	2	0	0	0	1	0	0	1	0	0	1	1	1	0	0	1	1	1	1	2	1	0	02	0	0	1	1	23	0	2	23	0	1	
<i>S. setafascis</i>	1	0	1	1	2	0	1	1	1	1	0	0	0	1	2	0	1	0	0	0	2	1	1	1	2	1	1	0	1	2	1	1	2	1	0	0	0	34	0	12	12	2	0	
<i>S. setiger</i>	1	0	0	?	?	0	0	1	1	0	1	0	0	0	1	0	0	0	0	0	1	1	1	1	2	0	0	0	0	1	1	0	0	0	0	0	0	5	1	2	3	2	0	
<i>S. striatufacies</i>	0	0	0	?	?	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	1	2	1	2	0	1	0	1	2	1	0	0	0	0	0	0	3	1	12	12	2	0	
<i>S. sulcaticeps</i>	0	0	1	1	2	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	2	3	2	1	2	0	0	0	1	2	1	0	0	1	0	0	0	34	12	1	23	1	01	
<i>S. tasmaniensis</i>	0	0	1	1	2	0	0	1	1	1	2	0	0	0	0	0	0	1	1	1	0	12	1	0	0	0	0	0	1	1	1	0	1	0	1	0	1	45	23	2	12	01	1	
<i>S. unidentis</i>	1	01	1	?	?	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0	2	3	1	0	0	0	0	0	1	1	2	1	0	0	0	1	1	1	3	0	0	01	0	12
<i>S. varipunctatus</i>	0	0	0	0	2	0	0	1	1	1	2	0	0	12	2	0	1	0	0	1	1	1	1	1	2	0	0	0	0	2	1	0	0	1	0	0	0	34	23	12	34	1	01	
<i>S. zborowskii</i>	0	1	1	?	?	0	0	?	1	0	0	0	0	0	2	0	1	0	1	0	2	2	1	1	2	0	1	1	1	2	1	0	0	0	0	0	0	3	0	1	2	1	0	

of Sanderson and Donoghue (1989), indicating an expected high level of homoplasy for this number of taxa.

The strict consensus tree (Fig. 6.1) is mostly unresolved and the TI of 0.16 suggests low support for the overall tree. However, several clades are recognised and have varying degrees of support. The clade at node 2 (Fig. 6.1), including *S. borrooloolensis* sp. nov. + *S. locustae* Dodd + *S. pilosus* Dodd + *S. setafascis* sp. nov., is supported by the highest decay index (9) and is defined by the presence of a dorsal mandibular tooth. This is the only unequivocal synapomorphy on the tree. The Scelionini genera *Dicroscelio* + *Acanthoscelio* + *Heptascelio* + *Oreiscelio* are grouped together within the clade at node 3 (Fig. 6.1) and are defined by the 12 segmented male antenna, a character state also shared with the outgroup. However, this clade has a low decay index (1). All ingroup taxa are defined by having a 10 segmented male antenna (Fig. 6.1, node 1) with a reversal to 12 segments for the above group of genera at node 3. The group of taxa at node 4 (Fig. 6.1) have the metasoma 2.5–3.0 times as long as wide, a state shared with *S. petilus* sp. nov., and have many other characters in common. However, none are unequivocal for the clade.

The unweighted data were successively reweighted based on the RC of the 7115 trees found. After three successive weightings, the tree structure remained constant, producing 27 equally parsimonious trees with a much improved CI of 0.41 and RI of 0.51. The strict consensus (Fig. 6.2) shows an almost fully resolved tree, except for relationships among several taxa within the apical clade at node 9. The RC values for each character indicates the influence of the characters on the analysis. Characters 5 (male antennal segment number) and 7 (dorsal mandibular tooth) were weighted highest with a value of 1.0. Although the males of numerous species are not known, character 5 is an unequivocal synapomorphy for all *Scelio* species, as well as *Lepidoscelio* and *Scelicerdo* (node 1), while the presence of a dorsal mandibular tooth is an unequivocal synapomorphy for *S. borrooloolensis* + *S. locustae* + *S. pilosus* + *S. setafascis* (node 8). Those characters which were weighted ≤ 0.10 were: 4, male antennal tyloids (0.44); 12, interantennal process carinae (0.20); 20, scutellum lateral nodes (0.17); 25, mesosternal sculpturing (0.16); 28, submarginal vein of fore wing (0.17); 29, Rs of fore wing (0.33); 35, S2 basal transverse ridge (0.10); 36, S2 felt fields (0.11); and 37, S3 felt fields (0.14). Characters which had no influence on the analysis (i.e. given a value of 0) were: 3, coxal colour; 8, apical mandibular tooth number; 9, frontal carina; 13, form of the speculum; 26, definition of stigmal spot; and 31, fore leg trochantellus. All other characters were weighted < 0.10 .

Taxa included in the clade at node 2 (Fig. 6.2) are defined by the presence of a basal transverse ridge on sternite 2 (character 35) (Figs 5.2, 8.109) but this state is reversed for five distant taxa, *S. joni* sp. nov., *S. naumanni* sp. nov., *S. nanocuspis* sp. nov. + *Scelicerdo*, and *Lepidoscelio*, and has an RC of 0.10.

Taxa included in the clade at node 3 (Fig. 6.2) are defined by the latero-ventral corners of the propodeum being round or square (character 33), but this state is reversed for two distant taxa, *S. littoralis* Dodd and *S. petilus*. This character had a very low RC of 0.04, but may have been improved by treating it as binary.

Taxa included in the clade at node 4 (Fig. 6.2) are defined by the mesosternum being sculptured (character 25), but this state is reversed for one node including *S. meridionalis* sp. nov. and *S. nigrobrunneus* Dodd. A sculptured mesosternum is also shared with the other scelionine genera (node 13), which here come out basally below all *Scelio* species. Homoplasy for this character could be reduced by treating it as binary (i.e. sculptured or smooth).

Taxa included in the clade at node 5 (Fig. 6.2) are defined by the mesopleuron being punctate (character 24). However, there are four reversals, i.e. *S. schmelio* sp. nov., *S. pilosus* Dodd, *S. nanocuspis* sp. nov. and the clade at node 10 (Fig 6.2). A punctate mesopleuron is also shared by two distant taxa, *Heptascelio* and *S. nigriscutellum* Dodd.

Character 43, the ratio of the lower to upper apical widths of tergite 1, defines two distinct groups: *Dicroscelio* + *Oreiscelio* + *Acanthoscelio* + *Heptascelio* is defined by the unequivocal

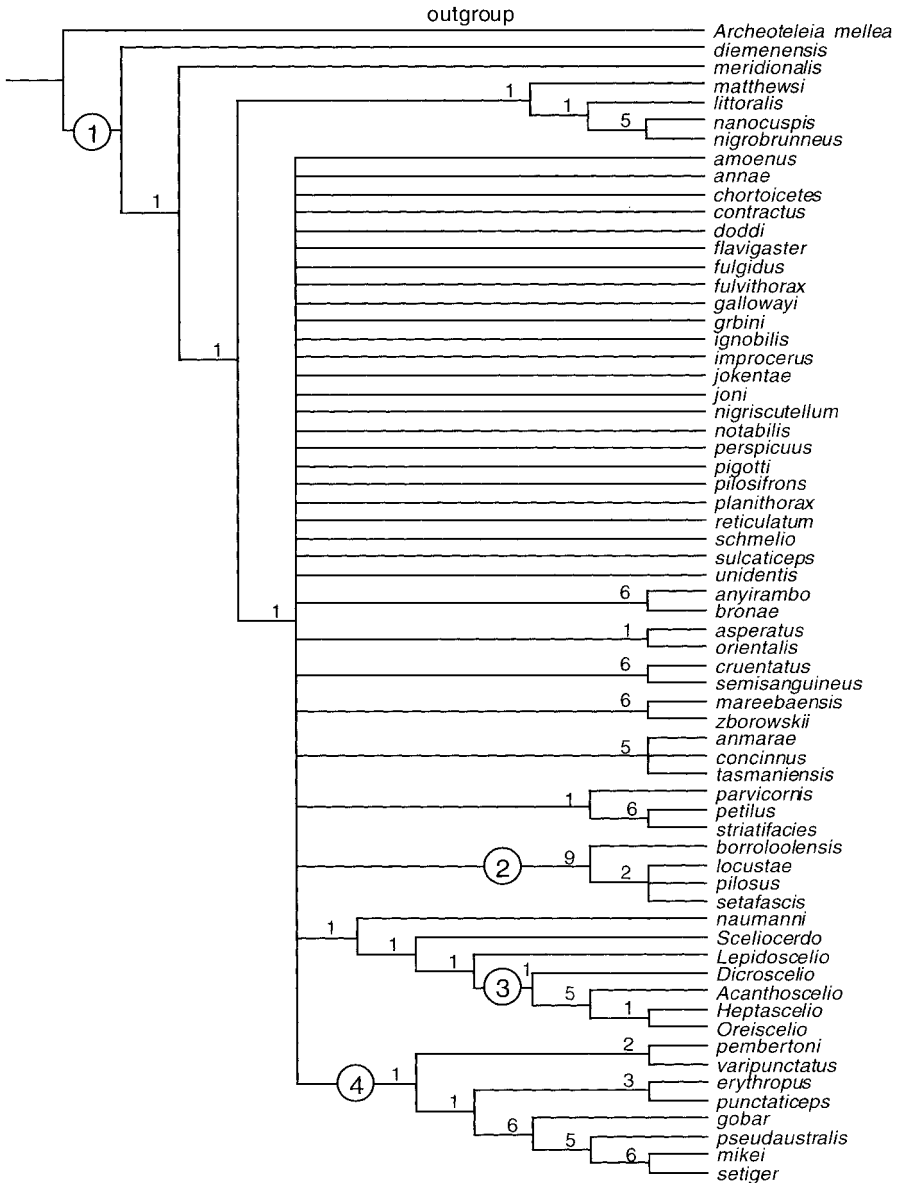


Fig. 6.1. Strict consensus of the 7115 most parsimonious trees of 553 steps with all characters treated as unpolarised and unordered (CI, 0.33; RI, 0.30; RC, 0.10; TI, 0.16). Decay indices are given above the branch for each node. Nodes defined by circled numbers 1 to 4 are discussed in the text.

synapomorphy of having a ratio >1.8 (i.e. upper width much narrower than lower), however this range incorporates three states; and the taxa at node 6 which are defined by having this ratio <1.3 but with three reversals, i.e. for *Lepidoscelio*, *Scelioecordo* and *S. nigrobrunneus*.

Taxa included in the clade at node 9 (Fig. 6.2) are defined by the presence of male antennal tyloids (character 4) also found in the outgroup, *A. mellea*. As for antennal segment number, this character could not be coded for numerous species because the male sex is not known for them.

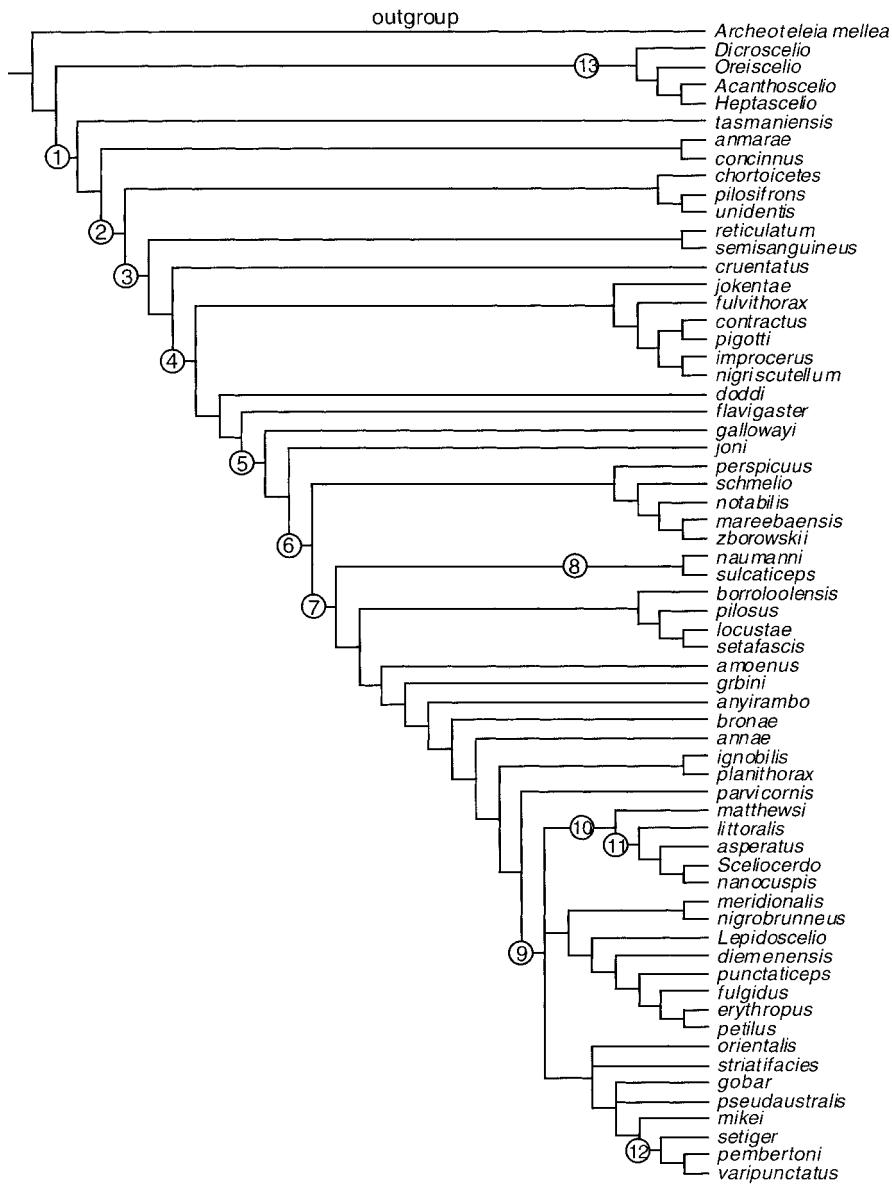


Fig. 6.2. Strict consensus of the 27 most parsimonious trees found after successively weighting data using the rescaled consistency index on all characters (CI, 0.41; RI, 0.51; RC, 0.21). Nodes defined by circled numbers 1 to 13 are discussed in the text.

Four taxa at node 11 (Fig. 6.2) are defined by having the interantennal process carinae continuing onto the speculum (character 12) (Fig. 8.14), a state which occurs independently in two other taxa, *Heptascelio* and *S. nigrobrunneus*. Three taxa at node 12 (Fig. 6.2) are defined by increased infuscation of vein Rs in the fore wing (character 29), a state also shared by the outgroup, *A. mellea*.

When morphometric characters are excluded and the data set re-analysed, the resulting 30 200 shortest trees (maximum limit) of 335 steps are very poorly resolved, the CI of 0.17 indicating an extreme level of homoplasy within the data. These results were not explored further.

CONCLUSIONS

The data set shows substantial homoplasy, with very low bootstrap values and a low total support index, indicating that the results are not particularly robust and should be treated as preliminary. However, reweighting using the successive approximations method produces better resolution, and a number of interesting aspects emerge. The male antennal characters are phylogenetically significant and association of males for species currently only known from females may greatly improve the stability of this phylogeny. *Scelio* is not monophyletic unless the scelionine genera *Lepidoscelio* and *Sceliocerdo* are included. These genera combined represent only six described species (Johnson 1992), compared with 225 species for *Scelio*, and so could be easily accommodated within *Scelio*. This may be extended to include other scelionine genera not included in this analysis that have males with 10 segmented antennae. Several groups of species consistently form monophyletic groups but a species-group classification is premature at this stage.

CHAPTER 7

Key to Australian Species of *Scelio*

Australian members of *Scelio* can be separated from other scelionid genera from the region using the key presented in Galloway and Austin (1984). For other regions of the world, the keys in Masner (1976b, 1980) are recommended.

Identification of *Scelio* species found in Australia can be facilitated by using the keys below. Because of the pronounced sexual dimorphism exhibited by the genus, separate keys for males and females are presented. As explained in Chapter 8, the revision of species has primarily used female characters, and all but one (*S. mannesi* sp. nov.) of the new species described here have been based on this sex. However, four previously described species (redescribed here) are known only from males. Additionally, we have recognised 26 putative species known only from males, which are recognised here as *Scelio* spp. A–Z and are diagnosed in Chapter 8. Some of these undoubtedly represent the unassociated males of species already described on the basis of the female sex. *Scelio nigricoxa* Dodd is only known from the male holotype and has not been included in the key because the head is missing. Three species from Indonesia, Papua New Guinea, and/or the Solomon Islands, *S. setiger* Brues, *S. pembertoni* Timberlake and *S. wallacei* Dodd, have been included in the keys and the phylogenetic analysis as they have previously been thought to occur in Australia and/or eventually may be recorded from the mainland (Chapter 6). However, they have been excluded from the taxonomic revision (Chapter 8) because they are currently considered as extra-limital to the study area, and there are numerous undescribed species from these regions. Some species key out twice due to morphological variability.

KEY TO SEXES

- ... Antenna 12 segmented, with distinct apical club, tyloids absent (Fig. 5.7); metasoma often elongate and tapering to a point at apex (Fig. 8.75) Females
- .. Antenna 10 segmented, mostly without apical club, segment 5 sometimes with tyloid present (Figs 5.6, 5.9–5.14); metasoma usually broadly rounded at apex (Fig. 8.71) Males

KEY TO FEMALES

- 1. Mandible unidentate, evenly pointed to apex (Fig. 8.225) 2
- Mandible bidentate, with two teeth of variable length, lower tooth sometimes reduced to small node (Figs 5.3, 8.151) 3
- 2(1). Dorsellum not emarginate medially (Figs 8.40, 8.42); body black to brown; T3 finely reticulate (Fig. 8.45); clypeal margin (Figs 8.32, 8.190) produced between lateral points, with medial margin concave to straight *S. chortoicetes* Froggatt
- Dorsellum weakly to moderately emarginate medially (Fig. 8.224); mesosoma with orange coloration; T3 mostly finely reticulate but with finely striate lateral and posterior borders (Fig. 8.224); clypeal margin not produced between lateral points, with medial margin broadly convex (Fig. 8.225) *S. unidentis* D & A, sp. nov.

- 3(1). Posterior propodeum in dorsal view not indented either side of nucha (Figs 8.24, 8.77, 8.171); malar region with radiating striae continuing dorsally of ventral edge of eye (Fig. 8.172) 4
 Posterior propodeum indented either side of nucha (Figs 5.1, 8.57); malar region variable 15
- 4(3). Basal mandible with reticulate sculpturing, apex smooth (Figs 8.19, 8.172) 5
 Basal mandible smooth (Fig. 8.121) 7
- 5(4). Interantennal process with lateral carinae arching around antennal socket, not onto frons (Fig. 8.172); S2–S5 virtually smooth to faintly rugulose-reticulate, with scattered fine to medium punctation, sometimes longitudinally strigose in extreme lateral parts; clypeus broad and moderately produced between lateral points, medial margin evenly convex (Fig. 8.172) [malar region with long radiating striae becoming punctate-reticulate near dorsal speculum; mesopleuron punctate-reticulate, sometimes striate medially] *S. orientalis* Dodd
- Interantennal process with lateral carinae continuing onto frons (Fig. 8.16), or if not clearly defined then S3–S5 with longitudinal striation throughout or with narrow smooth area medially (Fig. 8.13); clypeus narrow medially, well produced between lateral points with medial margin straight to slightly concave (Fig. 8.12) 6
- 6(5). Antero-dorsal scutum smooth (Fig. 8.131) [propodeum with ventro-lateral corners pointed or square; notauli broad and shallow, poorly defined amongst sculpturing of scutum] *S. littoralis* Dodd
- Antero-dorsal scutum with sculpturing similar to posterior scutum (Fig. 8.11) [S3–S5 with moderately fine longitudinal striation and narrow smooth medial longitudinal band (Fig. 8.13); malar region with long radiating striae becoming crenulate near dorsal speculum (Figs 8.12, 8.16); mesopleuron transversely striate to strigose; T3 reticulate to smooth medially, striate laterally (Fig. 8.22)] *S. asperatus* Dodd
- 7(4). Pilosity coarse on temples (Fig. 8.193) and dorso-lateral pronotum; mandible with dorsal tooth present (Fig. 8.194) 8
 Pilosity on body fine; mandible with dorsal tooth absent 11
- 8(7). Clypeal margin only slightly produced medially between lateral points, with medial clypeal margin concave so that the ventral carinae of the interantennal process touch the margin or at least the anteclypeus, often with the labrum exposed; anteclypeus very narrow (Fig. 8.134); coxae dark brown [metasoma 2.2–2.3 × as long as broad; T3 coarsely striate with background rugulosity throughout (Fig. 8.133) *S. locustae* Dodd, stat. rev.
- Clypeal margin prominently produced medially between lateral points, with straight or convex margin, shovel-like, interantennal process well separated from clypeal margin; anteclypeus broad; coxae variable in colour 9
- 9(8). Coxae yellow to orange; T3 longitudinally strigose with faint background reticulation 10
 Coxae brown; T3 longitudinally striate throughout with background reticulation (Fig. 8.189) [T2 strigose laterally, smoother medially] *S. pilosus* Dodd, stat. rev.

- 10(9). Body black to brown; fore wing with dark infuscation in apical two-thirds, with long coarse dark setae *S. setafascis* D & A, sp. nov.
Propodeum, metasoma and legs orange, head black; fore wing moderately lightly infuscate throughout with moderately short fine light brown setae
.....*S. borrooloolensis* D & A, sp. nov.
- 11(7). Dorsellum prominent, well raised above lateral metanotum (Fig. 8.124) 12
Dorsellum only slightly raised above lateral metanotum (Fig. 8.81) 13
- 12(11). Mandible with lower tooth reduced to small node, less than $0.2 \times$ length of upper tooth (Fig. 8.151) *S. nanocuspis* D & A, sp. nov.
Mandible with lower tooth $0.6 \times$ as long as upper tooth (Fig. 8.167)
..... *S. nigrobrunneus* Dodd (part)
- 13(11). Anterior scutum with sculpturing reduced, appearing smooth compared to posterior scutum (Figs 8.77, 8.80) [posterior vertex with moderately fine sparse punctation (Fig. 8.83); propodeum with ventro-lateral corners rounded; lateral lobes of scutum mostly smooth anteriorly; notauli narrow and moderately deeply defined (Fig. 8.77); mandibles with upper tooth much longer than lower tooth] *S. fulgidus* Crawford
Anterior scutum sculpturing not reduced, similar to posterior scutum 14
- 14(13). Postero-lateral corners of propodeum angled; notauli clearly defined against sculpturing of scutum; metasoma $2.4\text{--}2.6 \times$ as long as wide (Fig. 8.198)
.....*S. planithorax* Dodd
Postero-lateral corners of propodeum rounded; notauli not easily defined amongst coarse punctation of scutum; metasoma $2.0\text{--}2.3 \times$ as long as wide (Fig. 8.112) *S. ignobilis* Dodd
- 15(3). Pilosity coarse on temples and dorso-lateral pronotum 16
Pilosity fine on temples and dorso-lateral pronotum 24
- 16(15). Dorsellum emarginate medially 17
Dorsellum not emarginate medially 20
- 17(16). Clypeal margin not produced between lateral points, sometimes with medial notch; mandibles short, only just meeting medially, lower tooth much longer than upper (Fig. 8.187) [frons and vertex with sparse scattered punctures, posterior vertex with faint transverse striae; notauli clearly defined amongst punctation of scutum (Fig. 8.186)] *S. pilosifrons* Dodd
Clypeal margin usually produced and convex between lateral points, sometimes concave but never with medial notch; mandibles clearly overlapping medially, lower tooth shorter or subequal in length to upper tooth 18
- 18(17). Posterior vertex rugose-reticulate, not appearing transverse; dorsellum sometimes appearing only slightly emarginate medially, with short broadly rounded lateral points; coxae medium brown [T1 $0.4\text{--}0.5 \times$ as long as upper anterior width; metasoma $1.8\text{--}2.1 \times$ as long as wide] *S. pigotti* D & A, sp. nov.
Posterior vertex with distinctly transverse punctate-reticulate sculpturing; dorsellum deeply emarginate medially, produced posteriorly with pronounced lateral points, coxae mostly yellow, some light brown 19
- 19(18). Metasoma stout, $1.7\text{--}1.9 \times$ as long as wide (Fig. 8.57); body dark to medium brown except legs, basal antennae, mandibles and palps which are yellow ...
..... *S. contractus* Dodd
Metasoma $2.1\text{--}2.3 \times$ as long as wide (Figs 8.85, 8.96); body orange to yellow except head which is black and metasoma which is sometimes light brown ...
..... *S. fulvithorax* Dodd

- 20(16). T1 broad, $0.55 \times$ as long as upper anterior width; T3 and T4 finely reticulate; notauli moderately well defined (Fig. 8.210); head black, mesosoma and metasoma variably orange to medium brown [posterior vertex with transverse striae, head otherwise coarsely punctate (Fig. 8.210)] *S. semisanguineus* Girault, stat. rev.
T1 long and narrow, $0.6\text{--}1.0 \times$ as long as upper anterior width; T3 and T4 sculpturing variable but not finely reticulate; body dark brown to black . . . 21
- 21(20). Body small, 3.3–3.4 mm long; T3 and T4 smooth medially, becoming faintly strigose laterally [legs yellow; wings lightly infusate] *S. pseudaustralis* D & A, sp. nov.
Body much larger, 4.0–6.0 mm long; T3 and T4 mostly sculptured throughout, sometimes faint postero-medially 22
- 22(21). Mandibles with distinct reticulate sculpturing medially, smooth basally, striate to smooth at apex (Fig. 8.149); body generally robust in appearance; T3 coarsely reticulate throughout, with small band of striation laterally and posteriorly (Fig. 8.148) [legs brown or yellow; wings with darker infuscation in apical half] *S. miki* D & A, sp. nov.
Mandibles mostly smooth throughout, sometimes with scattered punctures medially; body generally slender in appearance; T3 and T4 coarsely strigose, medially with slight background rugulosity, strigation or smooth 23
- 23(22). Notauli not defined amongst sculpturing of scutum (Fig. 8.99); antennal segments 7–12 with small paired sensilla (Figs 8.105, 8.106); legs yellow [wings evenly infusate throughout; Australian] *S. gobar* Walker
Notauli defined amongst sculpturing of scutum; antennal segments 7–12 with large paired sensilla; legs dark brown [known only from Solomon Islands] *S. setiger* Brues
- 24(15). Anterior scutum with sculpturing very reduced, appearing smooth, contrasting with sculpturing of posterior scutum 25
Anterior scutum with sculpturing similar to posterior scutum 29
- 25(24). Malar region punctate, sometimes with very short radiating striae about basal mandibles [propodeum with postero-lateral corners pointed; medial scutum with faint longitudinal to oblique striae (Fig. 8.222)] *S. tasmaniensis* D & A, sp. nov.
Malar region smooth or with radiating striae continuing dorsally to ventral edge of eye 26
- 26(25). Posterior vertex strongly longitudinally striate (Fig. 8.220) [eyes large; dorsellum prominent and emarginate medially; scutum with deep punctation; propodeum deeply indented either side of nucha (Fig. 8.219); stigmal and apical vein (r) yellow and well defined] *S. sulcaticeps* Dodd
Posterior vertex variable, either punctate, rugulose, rugose-reticulate, smooth or transversely striate; scutum sculptured posteriorly [notaular definition variable; scutellum sparsely punctate or punctate-reticulate] 27
- 27(26). Posterior scutum with scattered punctation (Fig. 8.9) *S. anyirambo* D & A, sp. nov. (part)
Posterior scutum punctate-reticulate 28

28(27).	Propodeum with indentation about nucha narrow and deep, postero-lateral corners square; mesosoma brown; posterior and lateral scutum rugose-reticulate to punctate-reticulate (Fig. 8.179)	<i>S. perspicuus</i> Dodd
	Propodeum with indentations about nucha broad and shallow, postero-lateral corners square or pointed (Fig. 8.66); mesosoma orange; narrow lateral area of scutum smooth, usually with scattered punctures, posterior scutum punctate-reticulate	<i>S. doddi</i> D & A, sp. nov.
29(24).	Malar region smooth or with radiating striae, which may be faint or become partly reticulate dorsally, continuing to level of ventral eye	30
	Malar region punctate or distinctly rugose-reticulate, sometimes with a few very short radiating striae at edge of clypeal margin (Fig. 8.129)	51
30(29).	Malar region either smooth or with weakly defined faint radiating striae	31
	Malar region with well-defined coarse striae radiating about speculum	32
31(30).	Malar region with very faint radiating striae arching over and joined weakly above speculum (Fig. 8.5)	<i>S. anmarae</i> D & A, sp. nov.
	Malar region mostly smooth, at most with very faint radiating striae which do not meet above speculum (Fig. 8.55) [dorsal frons with small scattered punctures, posterior vertex with sparse transverse striae; scutum smooth antero-medially, notauli moderately well defined; T1 broad; T3 with faint medial reticulate-striate sculpturing; T4 and T5 smooth (Fig. 8.54)]	<i>S. concinnus</i> Dodd
32(30).	Dorso-lateral pronotum with radiating striae extending from outer part of transverse carina at shoulder (Fig. 8.110); head black, mesosoma orange except for scutellum, dorsellum, and metasoma which are light brown [vertex with well-spaced punctuation that appears slightly transverse on posterior vertex (Fig. 8.110); propodeum with arched transverse carina]	<i>S. grbini</i> D & A, sp. nov.
	Dorso-lateral pronotum punctate-reticulate to rugose-reticulate; body colour variable	33
33(32).	Medial vertex with fine pustulate background sculpturing and moderately coarse punctuation (Fig. 8.141)	<i>S. mareebaensis</i> D & A, sp. nov.
	Medial vertex variably sculptured but without fine pustulate background sculpturing	34
34(33).	Medial scutum strigose, strigose-reticulate or punctate and appearing distinctly longitudinal; T2–T4 coarsely striate, without background reticulation (Figs 8.145, 8.169)	35
	Medial scutum punctate or reticulate-punctate but not appearing longitudinal; T3 strigose, reticulate, or with background reticulation; T2 and T4 variable . .	37
35(34).	Dorsellum not raised above level of metanotum; T1 >0.6 × as long as upper anterior width (Fig. 8.145) [medial scutum with longitudinal striae or punctuation arranged in well-defined longitudinal lines; T3 strigose; posterior vertex sparsely punctate; notauli clearly defined amongst sculpturing (Fig. 8.145); mesosternum mostly smooth, with small scattered punctures; propodeum with postero-lateral corners moderately rounded	<i>S. meridionalis</i> D & A, sp. nov.
	Dorsellum raised well above level of metanotum; T1 ≤ 0.6 × as long as upper anterior width	36

- 36(35). Punctuation on vertex moderately sparse, appearing distinctly transverse, becoming substrate posteriorly (Fig. 8.169); mesosoma dark brown; dorsellum prominent, distinctly emarginate medially *S. notabilis* Dodd
Punctuation on posterior vertex densely reticulate (Fig. 8.229); mesosoma orange; dorsellum prominent, like a crimped fan, very slightly emarginate medially *S. zborowskii* D & A, sp. nov.
- 37(34). Dorsellum distinctly emarginate medially (Fig. 8.125) 38
Dorsellum at most only slightly emarginate medially 40
- 38(37). Dorso-lateral pronotum with scattered rugosity between lateral edge and dorsal scutum (Fig. 8.160); dorsal frons with reticulate punctuation (Fig. 8.161) *S. nigriscutellum* Dodd (part)
Dorso-lateral pronotum with distinct transverse carina between lateral edge and dorsal scutum; dorsal frons punctate 39
- 39(38). Striations on malar region meeting dorsally above elongate speculum, the speculum $2 \times$ as long as wide; propodeum and metasoma orange *S. naumanni* D & A, sp. nov.
Striations on malar region not meeting above speculum; body all black, legs variable in colour [lateral scutellum with well-defined lateral nodes (Fig. 8.3); legs, basal antenna and tegula yellow to orange; posterior vertex with reticulate punctuation (Fig. 8.3); body length 4–5 mm] *S. amoenus* Dodd
- 40(37). Scutum mostly smooth, with scattered punctuation (Fig. 8.9) [with anterior scutum sculpturing reduced; this species will generally key out at couplet 27] *S. anyirambo* D & A, sp. nov. (part)
Scutum with coarse punctate to punctate-reticulate sculpturing 41
- 41(40). Mandible with upper tooth about $3 \times$ as long as lower tooth (Fig. 8.175); legs brown, sometimes margined with yellow *S. parvicornis* Dodd
Mandible with upper tooth about $2 \times$ as long as lower tooth; legs all yellow 42
- 42(41). T1 with lower anterior width clearly wider than upper anterior width (Figs 8.97, 8.163) 43
T1 with lower anterior width approximately same as upper anterior width (Figs 8.63, 8.201) 47
- 43(42). Propodeum brown-black, metasoma brown-black or orange 44
Propodeum orange, dorsal scutum and metasoma either brown or orange 45
- 44(43). Vertex punctate (Fig. 8.7); mesopleuron with moderately fine punctuation; T1 with lower anterior width $1.4\text{--}1.45 \times$ upper anterior width *S. annae* D & A, sp. nov.
Vertex with well-defined reticulate punctuation (Fig. 8.163); mesopleuron transversely striate (Fig. 8.164); T1 with lower anterior width $1.6\text{--}2.0 \times$ upper anterior width (Fig. 8.163) *S. nigrobrunneus* Dodd (part)
- 45(43). Striations on malar region not meeting above speculum (Fig. 8.207); T2 with faint striations; medial T3–T4 finely reticulate [metasoma broad, $2.0\text{--}2.2 \times$ as long as wide] *S. schmelio* D & A, sp. nov.
Striations on malar region arching over and meeting horizontally above speculum; T1–T6 striate or strigose 46
- 46(45). T1–T6 striate (Fig. 8.75); metasoma orange *S. flavigaster* D & A, sp. nov.
T3–T4 strigose with background reticulation (Fig. 8.97); metasoma brown *S. gallowayi* D & A, sp. nov.

- 47(42). Notauli poorly defined amongst sculpturing on scutum, represented by coarser punctation amongst finer punctation or rugose-reticulation on rest of scutum (Figs 8.68, 8.201) 48
 Notauli clearly defined amongst sculpturing on scutum 50
- 48(47). T1–T5 longitudinally strigose throughout, without smooth medial patch (Fig. 8.201) *S. punctaticeps* Dodd
 T2–T4 longitudinally strigose with smooth medial patch; T1 and T5 variable (Fig. 8.63) 49
- 49(48). Scutum punctate (Fig. 8.63); funicle of antenna dark brown; coxae brown; S1–S3 longitudinally striate; S4 striate laterally, smooth medially; S5 smooth; S2 without felt nodes *S. diemenensis* Dodd
 Scutum punctate-reticulate (Fig. 8.68); funicle of antenna pale yellow; coxae yellow; S2–S5 virtually smooth; S2 with broad low felt nodes
 *S. erythropus* Dodd
- 50(47). Posterior vertex coarsely punctate to punctate-reticulate (Fig. 8.215); coxae light brown, rest of legs yellow *S. striatifacies* Dodd
 Posterior vertex with irregular transverse striae or rugulae (Fig. 8.143); coxae light to dark brown *S. matthewsi* D & A, sp. nov.
- 51(29). Mesopleuron punctate-reticulate 52
 Mesopleuron distinctly striate to strigate medially 57
- 52(51). Dorsal scutellum with variably developed lateral nodes (Fig. 8.227) 53
 Dorsal scutellum without lateral nodes 54
- 53(52). Dorsal scutum smooth, with coarse scattered punctation; notauli not defined (Fig. 8.227) [Australian] *S. varipunctatus* Dodd
 Dorsal scutum with coarse moderately dense punctation; notauli poorly defined as crenulate furrows [known from Malaysia and Indonesia]
 *S. pembertoni* Timberlake
- 54(52). Dorso-lateral pronotum with distinct transverse carina between outer edge and antero-dorsal scutum (Fig. 8.128) [metasoma orange, pronotum and dorsal scutum dark brown; notauli poorly defined; apical width of propodeum $0.4 \times$ medial length (Fig. 8.128)] *S. joni* D & A, sp. nov.
 Dorso-lateral pronotum with scattered rugosity between outer edge and dorsal scutum 55
- 55(54). Postero-lateral propodeum tapering to a point; body slender, $5.5 \times$ as long as wide; dorsal pronotum with sides straight and evenly narrowing anteriorly; T1 long and narrow (Fig. 8.182) *S. petilus* D & A, sp. nov.
 Postero-lateral propodeum moderately broad and square; body not as slender, $4\text{--}4.5 \times$ as long as wide; dorsal pronotum broadened abruptly with sides strongly emarginate; T1 moderately broad 56
- 56(55). Malar region without small radiating striae, distinctly punctate-reticulate throughout; interantennal process smooth medially (Fig. 8.28)
 *S. bronae* D & A, sp. nov.
 Malar region with small radiating striae, becoming strigose and reticulate dorsally; interantennal process with transverse medial carina (Fig. 8.161)
 *S. nigriscutellum* Dodd (part)

- 57(51). Posterior half of T2, T3 and T4 very finely rugulose (Fig. 8.205) [antero-lateral scutum virtually smooth, with large faint punctation] *S. reticulatum* D & A, sp. nov.
 T2 longitudinally striate, T3 and T4 with moderately coarse medial reticulation and lateral striation 58
- 58(57). Body orange apart from head which is black [T3 reticulate medially, striate laterally; T4 longitudinally striate; postero-lateral corners of propodeum slightly rounded; scutum strongly punctate-reticulate, becoming coarser and appearing elongate medially (Fig. 8.60)] *S. cruentatus* Dodd
 Body black to brown 59
- 59(58). Posterior vertex with well-developed transverse striae (Fig. 8.126) *S. jokentae* D & A, sp. nov.
 Posterior vertex punctate-reticulate, not appearing transverse (Fig. 8.118) *S. improcerus* Dodd

KEY TO MALES

1. Tyloid absent on antennal segment 5 (Figs 5.14–5.17) 2
 Tyloid present laterally on lateral antennal segment 5 (Figs 5.9–5.13) 24
- 2(1). Propodeum not indented either side of nucha (Fig. 8.46) 3
 Propodeum indented either side of nucha (Fig. 5.1) 7
- 3(2). Pilosity fine on temples and latero-dorsal pronotum 4
 Pilosity coarse on temples and latero-dorsal pronotum 5
- 4(3). T1 with lower anterior width $1.0\text{--}1.15 \times$ upper anterior width; T3–T5 longitudinally strigose *S. ignobilis* Dodd
 T1 with lower anterior width $1.3\text{--}1.65 \times$ upper anterior width; T3–T5 finely reticulate (Fig. 8.53) *S. chortoicetes* Froggatt (part)
- 5(3). Coxae yellow; apical part of stigmal vein (r) poorly defined by faint infuscation *S. setafascis* D & A, sp. nov.
 Coxae brown; apical part of stigmal vein (r) hyaline or yellow but distinctly tubular 6
- 6(5). T2 and T3 with very weak longitudinal striations; T3 virtually smooth medially (Fig. 8.71); fore wing with apical part of stigmal vein (r) tubular, buff-coloured to clear; wings hyaline *S. flavicornis* Dodd
 T2 and T3 with coarse well-defined striations (Fig. 8.136); T3 with background reticulation medially; fore wing with apical part of stigmal vein (r) yellow; wings lightly infusate *S. locustae* Dodd, stat. rev.
- 7(2). T1 elongate, $>0.55 \times$ as long as lower anterior width, lower anterior width mostly subequal to upper anterior width 8
 T1 broad, $<0.5 \times$ as long as lower anterior width, lower anterior width much wider than upper anterior width 14
- 8(7). Scutum smooth with scattered deep punctation; notauli defined by deep narrow crenulate grooves; ocelli large, $0.2 \times$ distance between eyes 9
 Scutum with coarse rugosity or reticulate punctation; notauli broad and moderately shallow; ocelli smaller, $0.1\text{--}0.15 \times$ distance between eyes 10

9(8).	S3 with raised smooth transverse band basally; mesopleuron finely punctate with medial smooth patch; fore wing venation moderately infusate	<i>S. sulcaticeps</i> Dodd
	S3 sculptured at base; mesopleuron finely punctate throughout; fore wing venation darkly infusate	<i>S. sp. A</i>
10(8).	Malar region with short weak radiating carinae that ventrally change to scattered punctuation about interantennal process and speculum	11
	Malar region with long coarse radiating carinae that emanate from medial speculum [body length 3.5–4.3 mm]	12
11(10).	T1 0.55–0.6 × as long as upper anterior width; postero-lateral corners of propodeum rounded [T3 with moderately coarse reticulate sculpturing; legs mostly brown; body length about 3.0 mm]	<i>S. sp. B</i>
	T1 >0.75 × as long as upper anterior width; postero-lateral corners of propodeum square	<i>S. sp. C</i>
12(10).	T1 0.85 × as long as upper anterior width; body length 4.3 mm [T3 with moderately coarse longitudinal strigose sculpturing, with background reticulation and postero-medial smooth patch; legs yellow to orange except for brown coxae; postero-lateral corners of propodeum slightly narrowed and rounded]	<i>S. sp. D</i>
	T1 0.6–0.75 × as long as upper anterior width; body length 3.5–3.9 mm	13
13(12).	Postero-lateral corners of propodeum rounded to obliquely truncate; fore wing with stigma defined as translucent tan-coloured spot with distinct long infusate apical vein (r); legs brown, yellow at joints	<i>S. sp. E</i>
	Postero-lateral corners of propodeum broad and square; fore wing with stigma defined as opaque buff-coloured spot with apical vein (r) spectral to slightly infusate; legs yellow except for brown coxae	<i>S. sp. F</i>
14(7).	In dorsal view frons with lateral margins sharply prominent, forming broad ridges about eye margins; notauli absent or virtually obliterated among moderately coarse punctate sculpturing of scutum [body black, coxa and scape light brown to dark yellow, rest of legs and antennae bright yellow; malar region with radiating striae becoming reticulate either side of speculum]	<i>S. sp. G</i>
	In dorsal view frons gently convex without lateral ridges about eye margins; notauli usually well defined at least posteriorly, sometimes indicated only by subtle change in sculpturing, scutum either smooth or sculptured	15
15(14).	Propodeum with narrow indentations about nucha [mesopleuron distinctly striate to strigose; antennae brown, legs yellow to brown, coxae brown; malar region with short radiating striae changing to punctate about interantennal process and speculum]	16
	Propodeum with broad and shallow indentations about nucha	22
16(15).	Dorsal metasoma broad, lens-shaped, its length 1.6–2.1 × as long as apical width of T3	17
	Dorsal metasoma narrower in apical half, broadest near base, tapering to apex, its length 2.15–2.7 × as long as apical width of T3	20
17(16).	Sternite 2 with elongate slightly raised lateral felt fields	species-group H
	Sternite 2 without felt fields	18
18(17).	Mesosternum smooth and shiny medially	species-group I
	Mesosternum sculptured medially	19

- 19(18). Forewing hyaline; notauli clearly defined among punctate sculpturing species-group J
Forewing lightly infusate; notauli variable from moderately well defined to indicated only by subtle change in sculpturing *S. improcerus* Dodd
- 20(16). Mesosternum smooth and shiny medially, sometimes with a few scattered punctures species-group K
Mesosternum distinctly sculptured medially 21
- 21(20). Sternite 2 with felt field present; fore wing infusate in antero-apical half species-group L
Sternite 2 with felt field absent; wings hyaline *S. sp. M*
- 22(15). Medial scutum mostly smooth with very sparse punctuation and narrow deep crenulate notauli (Fig. 8.138) [scutellum smooth with sparse punctuation laterally, longitudinally strigose medially; T3 smooth with medial patch of rugulose sculpturing; T4–T5 virtually smooth apart from narrow anterior transverse band of rugulose sculpturing (Fig. 8.138); posterior vertex with irregular transverse carinae (Fig. 8.138)] *S. mannesi* D & A, sp. nov.
Medial scutum distinctly sculptured, notauli variable 22
- 23(22). T3–T5 longitudinally striate [antero-dorsal scutum with medial line of rugulose sculpturing, posterior scutum rugulose; dorsellum wide with broad emargination; antenna and legs brown] *S. tasmaniensis* D & A, sp. nov.
T3–T5 finely reticulate (Fig. 8.53) [T1 with lower anterior width 1.3–1.65 × upper anterior width; propodeum with postero-lateral corners square; medial scutum with scattered broad punctuation (Fig. 8.46); mandibles bidentate but with very small lower tooth] *S. chortoicetes* Froggatt (part)
- 24(1). Basal mandible with distinct reticulate sculpturing 25
Basal mandible smooth 30
- 25(24). Interantennal process with lateral carina continuing around antennal sockets but not onto frons; S2–S5 with moderately sparse fine to medium punctuation, sometimes longitudinally strigose in extreme lateral part ... *S. orientalis* Dodd
Interantennal process with lateral carina continuing onto frons; S3–S5 with longitudinal striation throughout or with narrow medial smooth area 26
- 26(25). Propodeum with indentations about nucha distinct and moderately deep 27
Propodeum with indentations about nucha shallow or absent 28
- 27(26). Mandible reticulate medially, smooth basally; postero-lateral corners of propodeum tapering to a point; pilosity coarse on lateral pronotum and head *S. miki* D & A, sp. nov.
Mandible smooth medially, reticulate basally; postero-lateral corners of propodeum square; pilosity fine on lateral pronotum and head *S. sp. N*
- 28(26). Metasoma slender, broadest at T3, tapering to apex, with two pronounced apical points (Figs 8.24, 8.26); pilosity moderately coarse, especially on temples and lateral pronotum; dorsellum slightly prominent; T1–T5 with coarse longitudinal striations (Fig. 8.26) [mesopleuron punctate; S3–S5 with moderately coarse well-developed longitudinal striations throughout (Fig. 8.26)] *S. bipartitus* Kieffer
Metasoma broadest postero-medially, rounded at apex, without apical points; pilosity fine; dorsellum moderately prominent; T1–T5 coarsely strigose with medial reticulation, T3–T5 smooth postero-medially 29

29(27). Medial scutum evenly sculptured; postero-lateral corners of propodeum square *S. asperatus* Dodd
Antero-medial scutum smooth or with sparser punctation than posterior scutum;
postero-lateral margin of propodeum produced into point . . . *S. littoralis* Dodd

30(24). Propodeum with indentations about nucha shallow or absent 31
Propodeum with indentations about nucha deep 32

30(29). Latero-ventral corners of propodeum rounded; interantennal process with lateral
carina continuing around antennal socket but not onto frons; anterior scutum
with moderately sparse punctation; metasoma broadest postero-medially,
broadly rounded at apex; T1 with lower anterior width subequal to upper
anterior width *S. fulgidus* Crawford
Postero-lateral corners of propodeum square; interantennal process with lateral
carina continuing onto frons; anterior scutum with coarse reticulate-
punctation; metasoma broadest medially, tapering to apex; T1 with lower
anterior width wider than upper anterior width *S. nigrobrunneus* Dodd

32(30). Vertex with fine pustulate background sculpturing and coarse to moderately
coarse punctation species-group O
Vertex with either scattered or reticulate punctation but without fine background
pustulate sculpturing 33

33(32). Antennal segments 6–10 short and narrow, $0.75 \times$ length of scape, contrasting to
segments 2–5 which are much broader; medial vertex with area of diverging
striae [postero-lateral corners of propodeum broad; interantennal process with
lateral carina continuing onto frons; metasoma short broad and rounded at
apex; body 4.0–4.7 mm long, head and thorax broad so that body appears
stout] *S. sp. P*
Antennal segments 6–10, $1.0\text{--}1.3 \times$ length of scape, of similar width to segments
2–5; medial vertex punctate 34

34(33). In dorsal view frons with lateral margins sharply prominent forming broad ridges
about eye margins *S. sp. Q*
In dorsal view frons gently convex, without broad ridges about eye margins . . 35

35(34). Pilosity fine on temples; dorsellum variable; T1 variable 36
Pilosity coarse on temples; dorsellum moderately raised, not emarginate
medially; T1 elongate 47

36(35). Dorsellum raised well above lateral metanotum, emarginate medially 37
Dorsellum slightly to moderately raised above lateral metanotum, not emarginate
medially 39

37(36). Lateral nodes of scutellum not enlarged; T1 $0.35\text{--}0.45 \times$ as long as lower anterior
width species-group R
Lateral nodes of scutellum moderately large and directed posteriorly; T1 $0.6 \times$ as
long as lower anterior width 38

38(37). Basal antenna, tegula and legs dark brown, rest of antenna light brown; posterior
vertex with moderately sparse punctation; body large, about 6.5 mm in length
. *S. wallacei* Dodd
Antenna, tegula and legs yellow to light brown; posterior vertex with moderately
dense reticulate punctation; body small, about 4.5 mm length
. *S. pembertoni* Timberlake

- 39(36). T1 broad, $0.3\text{--}0.4 \times$ as long as lower anterior width, $<0.5 \times$ as long as upper anterior width (Fig. 8.155) [tyloids elongate but with prominent subapical raised node; notauli moderately well defined; apical width of propodeum $0.74 \times$ medial length (Fig. 8.155)] *S. nigricornis* Dodd
T1 narrower, $0.5\text{--}0.8 \times$ as long as lower anterior width, $>0.6 \times$ as long as upper anterior width 40
- 40(39). Punctuation on medial scutum with distinctly longitudinal trend [malar region with radiating striae; T1 $>0.7 \times$ as long as upper anterior width]
..... *S. meridionalis* D & A, sp. nov.
Scutum and scutellum with moderately coarse punctuation, without longitudinal trend 41
- 41(40). Mesosternum mostly smooth ventro-medially, with scattered moderately fine punctuation laterally 42
Mesosternum with well-defined uniform sculpturing throughout 43
- 42(41). T2–T3 moderately finely striate-reticulate, sometimes with small medial smooth patch; T4–T6 virtually smooth and shiny *S. parvicornis* Dodd
T2–T6 distinctly strigose species-group S
- 43(41). Antenna with dark scape, rest of antenna brown, clava becoming lighter to yellow apically 44
Antennae dark brown throughout 46
- 44(43). Metasoma elongate, $>3 \times$ as long as wide; scutum with sparsely scattered large punctures; dorsal scutellum with lateral nodes *S. varipunctatus* Dodd
Metasoma not as elongate, $<2.5 \times$ as long as wide; scutum with coarse dense reticulate-punctuation; dorsal scutellum without lateral nodes 45
- 45(44). T3 finely reticulate *S. sp. T*
T3 longitudinally striate with background reticulation *S. sp. U*
- 46(43). Vertex with distinct coarse sparse punctuation and fine background rugulosity [antero-medial scutum also with distinct coarse sparse punctuation and fine background rugulosity, lateral scutum smooth with sparse coarse punctures]
..... *S. sp. V*
Vertex with coarse dense punctures, without background rugulosity
..... species-group W
- 47(35). Body small, 3.3–3.8 mm in length; T3–T4 with smooth broad medial patch
..... *S. sp. X*
Body larger, 4.0–6.0 mm in length; T3–T4 mostly striate-reticulate, smoother postero-medially 48
- 48(47). Metasoma elongate, $>3.0 \times$ as long as wide *S. sp. Y*
Metasoma $<2.5 \times$ as long as wide 49
- 49(48). Coxae yellow to brown, remainder of legs and apical antenna yellow to orange [dorsellum moderately prominent; malar region with short striae ventrally, becoming punctate dorsally; mesopleuron punctate; antennal segment 5 with elongate tyloid] *S. gobar* Walker
Legs and apical antenna brown to black *S. sp. Z*

CHAPTER 8

Taxonomy of Australian *Scelio*

SCELIO LATREILLE

Scelio Latreille, 1805: 226; - Ashmead, 1893: 210, 211, 241; Kieffer, 1926: 264, 268, 308; Dodd, 1927: 128; Nixon, 1958: 303; Muesebeck, 1972: 3; Masner 1976b: 17; Galloway & Austin 1984: 10; Austin & Field, 1997: 11 (see Johnson, 1992: 471 for complete bibliography and extra-limital synonyms).

DIAGNOSIS

Speculum on frons not margined or depressed; mandibles bidentate (rarely unidentate); female antenna 12 segmented, clava gradually widening, not abruptly developed; male antenna 10 segmented, sometimes with tyloid present on segment 5; scutellum usually rounded posteriorly, sometimes slightly flattened; metanotum mostly undeveloped medially, sometimes with small bidentate dorsellum; submarginal vein in fore wing remote from wing margin, often unpigmented in distal part; marginal vein and basal part of stigmal vein usually forming a stigmal spot (pseudostigma); ovipositor system telescopic, with 2 or 3 sections to telescopic tube; ovipositor elongate, $0.8\text{--}0.9 \times$ length of metasoma; T7 + 8 no more sclerotised than distal part of telescopic tube, posterior margin with a few setae; cerci present and lobe- to leaf-shaped; lateral apodemes incorporated into wall of telescopic tube, distinct throughout, about $0.75 \times$ length of ovipositor; S6 without medial apodeme.

RELATIONSHIPS

The phylogenetic relationships among the Scelionidae are far from resolved, even though the current tribal and generic level classification (see Masner 1976b; Galloway & Austin 1984) has provided a sound framework for taxonomic studies over the last 20 years. Many of the currently recognised tribes and numerous genera are not defined by synapomorphies, although many of them are easily recognised. Austin and Field (1997) examined the ovipositor system of the Scelionidae and Platygasteridae (see Chapter 5) and recognised a large monophyletic group within the Scelioninae which is defined by the presence of a telescopic ovipositor tube for ovipositor extension (i.e. the *Scelio*-type system). This character is probably unique within the Hymenoptera and represents a putative synapomorphy for seven currently recognised tribes and some 55 genera. Austin and Field (1997) referred to this group as the Scelionini *sensu lato*. The Scelionini *s. str.* (i.e. *sensu* Masner 1976b) clearly belongs to this group. It contains 10 genera, *viz.* *Acanthoscelio* Ashmead, *Dicroscelio* Kieffer, *Freniger* Szabó, *Heptascelio* Kieffer, *Sceliocerdo* Muesebeck, *Lepidoscelio* Kieffer, *Oreiscelio* Kieffer, *Pseudohepta-scelio* Szabó, *Scelio* and *Synoditella* Muesebeck. The first five of these genera are monotypic and all except *Heptascelio*, *Lepidoscelio* and *Scelio* have restricted zoogeographic distributions. *Scelio* contains well over 90% of the 225 species described for the tribe (Johnson 1992).

The tribe Scelionini was conceived by Kozlov (1970) as a much broader group of genera as he also included *Nixonia* Masner, *Sparasion* L., *Sceliomorpha* Ashmead and *Amblyscelio* Kieffer. However, these genera have now been transferred to other tribes (Masner 1976b), with all but *Amblyscelio* lacking a telescopic ovipositor system. Masner (1976b) redefined the Scelionini *s. str.*, which is now recognised by a single putative synapomorphy, the incomplete

submarginal vein in the hind wing. In addition, available host data indicate that members of the tribe are virtually restricted to eggs of the Acrididae (Austin & Field 1997; Chapter 4), with two non-Australian species known from pyrgomorphid eggs. All other characters that are currently used to recognise the tribe are plesiomorphic or their polarity is unknown.

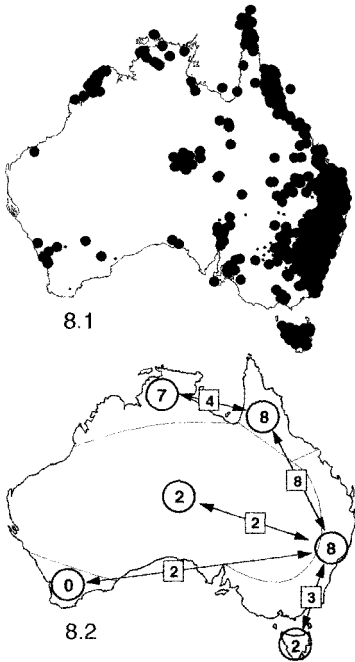
The phylogenetic status of *Scelio* remains unclear but, based on the phylogenetic analysis undertaken in Chapter 6, it is likely that the genus is not monophyletic unless both *Lepidoscelio* and *Sceliocerdo* are also included. Along with *Scelio*, these genera share a single synapomorphy, the male antenna being 10 segmented. *Synoditella* may also belong in this group given the male antenna is reduced to 10 segments (Muesebeck 1972) but no material was available to include in the analysis. The genera that come out basally in Figure 6.2 all have 12 segmented male antennae, while the males of two other genera, *Freniger* and *Pseudoheptascelio*, are unknown. Clearly, relationships among genera in the Scelionini *s. str.* need to be examined in more detail and on a worldwide basis, but the preliminary analysis undertaken here provides at least some insight into the phylogeny of the tribe.

SEXUAL DIMORPHISM

Scelio species display a significant level of sexual dimorphism, which includes differences in the shape of the antennae, number of antennal segments, body colour and dimensions, and sculpturing. This phenomenon has complicated the association of sexes, and in the past has resulted in problems in recognising some species (see discussion in Chapter 4). This situation is partly exacerbated by the fact that males and females of some species have quite separate emergence times and may not be collected together. However, in this study we have taken a pragmatic approach and only described new species on the basis of females (with the exception of the highly distinctive *S. mannesi* sp. nov.). We have also provided a key to all known males and diagnostic notes to species or species-groups not formally described. In several cases, we have taken species out of synonymy and reinstated them as valid taxa, where there is apparently no reasonable justification for the original synonymy. This applies to *S. locustae* Dodd, *S. nigricoxa* Dodd and *S. semisanguineus* Girault but most importantly to *S. gobar* Walker (= *S. australis* Froggatt) where removal from synonymy has had substantial implications for the interpretation of host relationships of *S. bipartitus* Kieffer (see Chapter 4). In a few cases we have been able to positively associate the sexes of a species on the basis of their being reared together.

DISTRIBUTION AND COMPOSITION OF THE AUSTRALIAN FAUNA

Including the new taxa described here, 58 species of *Scelio* are known from mainland Australia and Tasmania. Of these, 20 are known from both sexes, 34 recorded from females, and 4 only from males. The genus is widely distributed across the continent and has been collected from most habitats. The number of localities from which the genus has been recorded in Australia is strongly biased towards the eastern margin of the continent, including Tasmania, and extending into inland NSW and Queensland (Fig. 8.1). However, the genus is also known from northern and north-west Australia, the south-west (north of Perth), and central Australia, particularly around Alice Springs. No specimens are known from inland Western Australia and South Australia, except for the Flinders Ranges. It is unclear whether the absence of *Scelio* from these regions is real or an artefact of poor collecting. The concentration of sites around Alice Springs indicates that the genus is clearly present in arid regions, but this is also an area of slightly elevated rainfall compared with other areas, because of the precipitation that occurs over the MacDonnell Ranges, a situation paralleled by the Flinders Ranges in South Australia.



Figs 8.1, 8.2. Distribution of *Scelio* in Australia – specimens examined during this study (large dots) and collection sites of Baker *et al.* (1996) (small dots); **8.1.** All localities at which *Scelio* has been collected. **8.2.** Regional endemism of *Scelio*, showing number of species restricted to faunal regions (numbers in circles) and shared between them (numbers in squares) (see text for further explanation).

When the level of species endemism is examined for the major faunal regions of Australia, the same general pattern is evident. Of those species that have a restricted distribution, half (29) of all *Scelio* species are found in the eastern part of the continent: eight are restricted to the north-eastern Torresian, eight to the eastern mainland Bassian, two to Tasmania, while eight are shared between the north-eastern Torresian and eastern Bassian, and three between the latter region and Tasmania. Eleven species are known from the north-western Torresian region; seven are endemic of which three are restricted to the Kimberleys, and four have a broad northern distribution and are known from both the north-eastern and north-western Torresian. Significantly, only two species, *S. anmarae* sp. nov. and *S. unidentis* sp. nov., which are sister species in the phylogenetic analysis (Fig. 6.2), are restricted to the arid inland (Eyrean region), and no species are endemic to the south-western part of Western Australia, an area that has otherwise yielded many locally endemic parasitic Hymenoptera.

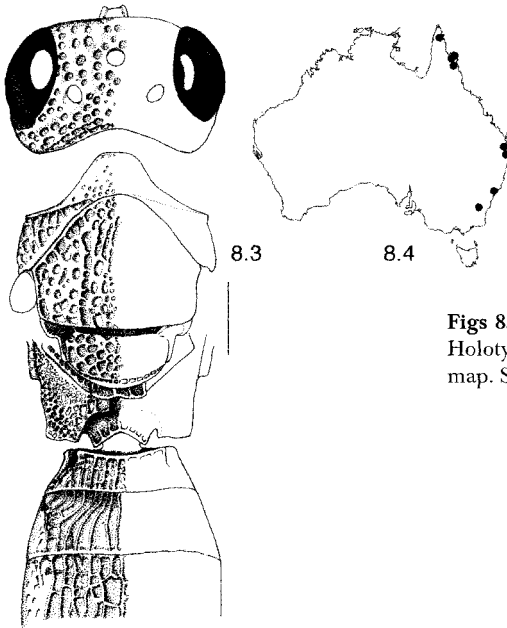
When the data presented in Figure 8.2 are compared with the results of the phylogenetic analysis (Fig. 6.2), a number of monophyletic groups are found to have restricted distributions, and possibly represent local radiations. For instance, the clade containing *S. notabilis* Dodd, *S. mareebaensis* sp. nov. and *S. zborowskii* sp. nov., defined by having the medial sculpturing on the scutum with a distinct longitudinal trend, is restricted to northern Queensland (north-eastern Torresian). *Scelio ignobilis* Dodd + *S. planithorax* Dodd are restricted to southern Queensland and northern New South Wales (central Bassian), while *S. erythropus* Dodd + *S. petilus* sp. nov. are found only in north Australia (eastern and western Torresian). The only clade in the phylogenetic analysis defined by an unequivocal synapomorphy (Fig. 6.2, node 8) contains several species that have similar distributions, although some are more dispersed than others. *Scelio borrooloolensis* sp. nov. is found in north-eastern Northern Territory, *S. pilosus* Dodd from Queensland, northern Northern Territory and Papua New Guinea, *S. locustae* from northern Western Australia and along the east coast from north Queensland to northern New South Wales, and *S. setafascis* sp. nov. is known only from northern Australia and Papua New Guinea.

TREATMENT OF SPECIES

SCELIO AMOENUS DODD

(Figs 8.3, 8.4)

Scelio amoenus Dodd, 1927: 159.- Galloway, 1976: 104; Galloway & Austin 1984: 10; Johnson, 1992: 474.



Figs 8.3, 8.4. *Scelio amoenus* Dodd: 8.3. ♀ Holotype, dorsal head to T3. 8.4. Distribution map. Scale line: 8.3, 0.25 mm.

Material examined

Holotype

♀, Queensland, 'Mooloolah Queensland A.P. Dodd' (SAMA).

Other material examined

Queensland: 1 ♀, 8.4 km SE Chillagoe on road to Mareeba, 17.12S, 144.33E, 31 Mar. 1992, E.C. Dahms, G. Sarnes (QMBA); 2 ♀, 14 km WbyN Hope Vale Mission, 15.16S, 144.59E, 7–10 May 1981, I.D. Naumann, Y.P.T. (ANIC); 1 ♀, Iron Range, Cape York Peninsula, 1–9 Jun. 1971, S.R. Monteith (ANIC); 1 ♀, 3.5 km SWbyW Mt Baird, 15.10S, 145.07E, 3–5 May 1981, I.D. Naumann, Y.P.T. (ANIC); 2 ♀, Mt Tamborine, 17–27 Mar. 1981, M.T. open forest, no collector (ASCU). **New South Wales:** 1 ♀, Brisbane Water National Park, Warrah Trig, 10 Dec. 1986, D.B. McCorquodale (ANIC). **Australian Capital Territory:** 1 ♀, Piccadilly Circus, 35.22S, 148.48E, 1240m, Mar. 1984, J. Lawrence, T. Weir, M-L. Johnson, F.I.T. (ANIC).

Female

Length

4.5–5.0 mm (mean 4.65 mm).

Colour

Dark brown except legs, mandibles, antennal toruli, scape and pedicel yellow.

Head

Width between eyes $0.49\text{--}0.51 \times$ width of head in dorsal view; OOL $0.04\text{--}0.08$ mm; LOL $0.21\text{--}0.31$ mm; POL $0.36\text{--}0.5$ mm; ocellar diameter $0.01\text{--}0.11$ mm, $0.15\text{--}0.18 \times$ width between eyes; head with short, fine, translucent pilosity, slightly coarser at temples; occiput strigose to rugulose-reticulate; posterior vertex punctate-reticulate with slight transverse trend; medial vertex and dorsal frons with coarse punctation; malar region with well-defined, radiating striae continuing halfway up frons; malar space $0.45\text{--}0.58 \times$ as long as eye height; interantennal process short, narrowed ventrally, with lateral carinae; clypeus well produced between lateral points, with medial margin straight; anteclypeus defined by smooth raised marginal area; mandibles smooth, lower tooth $0.3\text{--}0.36 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, long, translucent, slightly coarser on lateral pronotum, scutum and posterior scutellum; dorsal pronotum punctate; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum rugose-reticulate; pronotal shoulders prominent, defined by transverse carina; scutum with moderately coarse punctation; notauli poorly defined amongst sculpturing; scutellum with coarse punctation, no lateral spines defined; dorsellum prominent, moderately emarginate with latero-ventral edges rounded; mesopleuron punctate-reticulate; mesosternum punctate; propodeum $0.31\text{--}0.43 \times$ as long as wide, punctate-reticulate to rugose-reticulate about medial longitudinal furrow, with fine, moderately long, translucent pilosity throughout, postero-lateral area square; indentation about nucha present.

Wings

Lightly infusate, becoming darker in apical two-thirds, with short fine setae; stigmal spot moderately dark around stigmal vein.

Metasoma

$2.17\text{--}2.35 \times$ as long as wide; with fine, moderately long, translucent pilosity, becoming coarser towards apex; T1 $0.44\text{--}0.57 \times$ as long as upper anterior width, $0.35\text{--}0.44 \times$ as long as lower anterior width, longitudinally strigose with background reticulation; T2 longitudinally strigose, becoming rugose-reticulate laterally; T3 coarsely rugose-reticulate in anterior half, becoming strigose posteriorly; T4–T5 longitudinally strigose; T6 punctate-reticulate; S1–S2 rugose-reticulate with medial longitudinal carina; S3–S5 punctate-reticulate; S2 with shallow basal transverse ridge; S2–S3 with felt nodes defined.

Male

Unknown.

Distribution

This species appears to be restricted to eastern Australia, having been recorded from northern Queensland to the ACT (Fig. 8.4).

Host

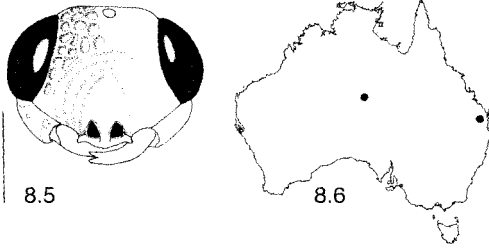
Unknown.

Comments

Scelio amoenus falls out basally in the phylogenetic analysis (Fig. 6.2) within the group that has the lower and upper anterior widths of T1 subequal, i.e. the ratio less than 1.3:1.0. Males previously considered to belong to this species have been removed from it and assigned to more than one group of undescribed males. The analysis infers that males of this species lack antennal tyloids.

***SCELIO ANMARAE* DANGERFIELD & AUSTIN SP. NOV.**

(Figs 8.5, 8.6)



Figs 8.5, 8.6. *Scelio anmarae* sp. nov.: **8.5.** ♀ Holotype, anterior head. **8.6.** Distribution map. Scale line: 8.5, 0.25 mm.

Material examined

Holotype

♀, Northern Territory, '24.03S 133.37E 42 km SWbyS Alice Springs 6 May 1978 NT J.C. Cardale' (ANIC).

Paratype

Queensland: 1 ♀, Chinchilla, Nov. 1926, A.P. Dodd (ANIC).

Female

Length

2.75–2.9 mm (mean 2.8 mm).

Colour

Orange-brown except head black, scutellum, metanotum and lateral tergites brown.

Head

Width between eyes $0.51 \times$ width of head in dorsal view; OOL 0.06 mm; LOL 0.18 mm; POL 0.28 mm; ocellar diameter 0.06 mm, $0.14 \times$ width between eyes; head with pilosity fine and sparse, slightly denser on face; occiput finely striate from foramen to vertex, with fine lateral striae; occipital carina present; posterior vertex sparsely reticulate with transverse trend; medial vertex smooth; dorsal frons punctate; malar region with faint sparse radiating striae meeting above speculum; malar space $0.4\text{--}0.45 \times$ as long as eye height; interantennal process virtually smooth, with well-defined lateral carinae; clypeus produced between lateral points, slightly convex medially; anteclypeus not defined by carina; mandibles smooth, lower tooth $0.55 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Dorsal pronotum faintly punctate-striate; latero-dorsal pronotum sparsely crenulate; latero-ventral pronotum faintly striate; pronotal shoulders partly defined laterally; anterior scutum virtually smooth with faint crenulae, posterior scutum faintly reticulate-punctate, lateral scutum faintly punctate; notauli poorly defined as shallow crenulate furrows, weaker anteriorly; scutellum crenulate laterally, longitudinally striate medially, no lateral spines defined; dorsellum prominent, clearly emarginate; mesopleuron striate; mesosternum smooth; propodeum $0.44\text{--}0.47 \times$ as long as wide, sparsely reticulate-crenulate, medial longitudinal furrow present, with sparse fine pilosity laterally, postero-lateral area pointed; indentation about nucha broad and shallow.

Wings

Lightly infusate, with fine short setae; stigmal spot defined as translucent oval node around stigmal vein.

Metasoma

1.9–2.1 × as long as wide, with sparse lateral pilosity; T1 0.38–0.47 × as long as upper anterior width, 0.26–0.32 × as long as lower anterior width, with longitudinal striae; T2 with faint longitudinal striae; T3 with faint lateral striae and medial reticulation; T4 with very faint striae, T5 medially striate; T6 striate; S1 crenulate; S2 basally striate with faint apical crenulation, S3–5 virtually smooth; S2 without felt lines or nodes defined.

Male

Unknown.

Distribution

Scelio anmarae is known from only two female specimens collected in southern central Queensland and southern Northern Territory (Fig. 8.6).

Host

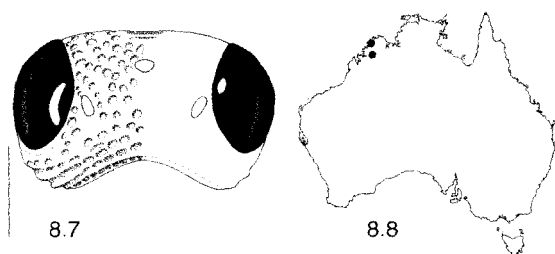
Unknown.

Comments

This species comes out as the sister taxon to *S. concinnus* Dodd in the phylogenetic analysis (Fig. 6.2). Males are inferred from the analysis as lacking antennal tyloids. Both of these species have the body small, short and broad, the transverse pronotal carina absent, the latero-ventral corners of the propodeum pointed, and similar distributions. However, they can be distinguished in that *S. concinnus* has an orange scutum, a complete occipital carina, the notauli clearly defined, and the latero-ventral pronotum sculptured. *Scelio anmarae* is named after Anne-Marie Dangerfield.

SCELIO ANNAE DANGERFIELD & AUSTIN SP. NOV.

(Figs 8.7, 8.8)



Figs 8.7, 8.8. *Scelio annae* sp. nov.:
8.7. ♀ Holotype, dorsal head.
8.8. Distribution map. Scale line: 8.7,
0.25 mm.

Material examined

Holotype

♀, Western Australia, '16.22S 125.12E W.A. Charnley Riv. 2 km SW Rolly Hill CALM Site 25/2 16–20 Jun. 1988 I.D. Naumann' (ANIC).

Paratype

Western Australia: 1 ♀, CALM Site 28/3, 4 km W of King Cascade, 15.36S, 125.15E, 12–16 Jun. 1988, T.A. Weir (ANIC).

Female*Length*

4.75–5.0 mm (mean 4.9 mm).

Colour

Brown-black except legs and basal antennae yellow, mandibles tan.

Head

Width between eyes $0.5 \times$ width of head in dorsal view; OOL 0.04 mm; LOL 0.25 mm; POL 0.43 mm; ocellar diameter 0.09–0.11 mm, $0.17\text{--}0.33 \times$ width between eyes; head with fine short pilosity; occiput striate from foramen to vertex; occipital carina mostly obscured by sculpturing; posterior vertex with even coarse punctation, continuing onto medial vertex and frons; malar region with coarse radiating striae, continuing halfway up face and meeting above speculum; malar space $0.47\text{--}0.58 \times$ as long as eye height; interantennal process crenulate with well-defined lateral carinae; clypeus narrowly produced between lateral points, medial apex slightly concave; anteclypeus defined by smooth transverse ledge; mandibles smooth, lower tooth $0.55\text{--}0.6 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Dorsal pronotum moderately punctate; latero-dorsal pronotum reticulate-punctate; latero-ventral pronotum reticulate-striate; pronotal shoulders prominent defined by carina; anterior and posterior scutum punctate, lateral scutum coarsely punctate; notauli weakly defined amongst punctation; scutellum punctate-reticulate, without lateral spines; dorsellum prominent and flared, not emarginate; mesopleuron punctate-reticulate; mesosternum crenulate posteriorly, anteriorly with medial smooth patch; propodeum $0.27\text{--}0.36 \times$ as long as wide, punctate-reticulate, medial longitudinal furrow defined anteriorly, white fine pilosity laterally, postero-lateral area square; indentation about nucha present.

Wings

Lightly infusate, with fine moderately long setae; stigmal spot defined as heavily infusate oval node around stigmal vein.

Metasoma

$2.2\text{--}2.7 \times$ as long as wide, with short fine sparse pilosity; T1 $0.5\text{--}0.65 \times$ as long as upper anterior width, $0.42\text{--}0.43 \times$ as long as lower anterior width, with longitudinal striae and well-defined background reticulation; T2 with longitudinal striae and background reticulation; T3 and T4 as for T2, with smooth to lightly reticulate medial patch; T5 with longitudinal striae; T6 coarsely reticulate-punctate; S1–5 reticulate-punctate; S2 with basal transverse ridge, felt nodes defined.

Male

Unknown.

Distribution

Scelio annae is only known from two female specimens collected in the remote north-west of Western Australia (Fig. 8.8).

Host

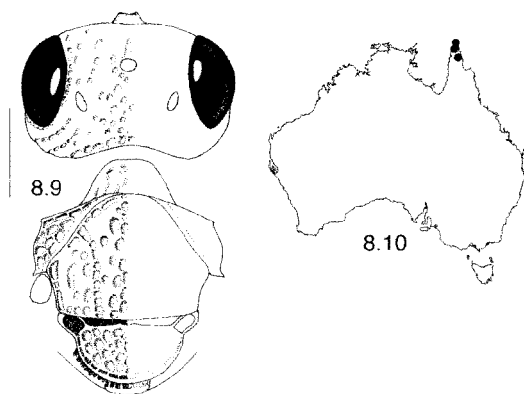
Unknown.

Comments

Although this species is similar to *S. asperatus*, differing only in the punctuation on the head and shape of T1, it is resolved in the phylogenetic analysis as part of the clade defined by having the lower anterior to upper anterior widths of T1 subequal, i.e. the ratio less than 1.3:1.0 (Fig. 6.2). Males of this species are inferred from the analysis as lacking antennal tyloids. *Scelio annae* is named after Anna Margaret Mayo.

SCELIO ANYIRAMBO DANGERFIELD & AUSTIN SP. NOV.

(Figs 8.9, 8.10)



Figs 8.9, 8.10. *Scelio anyirambo* sp. nov.: 8.9. ♀ Holotype, dorsal head to metanotum. 8.10. Distribution map. Scale line: 8.9, 0.25 mm.

Material examined

Holotype

♀, Queensland, '11.51S 142.38E QLD 12 km SSE Heathlands 1–21 Mar 1992, P. Feehney, closed forest MALAISE-#3#4' (ANIC).

Paratypes

Queensland: 2 ♀, Cockatoo Creek, 11.39S, 142.27E, 7 Feb.–5 Apr. 1993, P. Zborowski, M.T. (ANIC); 1 ♀, Cockatoo Creek, 17 km NW Heathlands, 11.39S, 142.27E, 26 Jan.–29 Feb. 1992, P. Feehney, open forest, M.T.#5 (ANIC); 1 ♀, Heathlands 11.45S, 142.35E, 25 Jul.–18 Aug. 1992, P. Zborowski & J. Cardale, M.T. (ANIC); 2 ♀, 15–26 Jan. 1992, I. Naumann, T Weir, yellow dishes (ANIC); 1 ♀, 26 Jan.–29 Feb. 1992, P. Feehney, M.T.#2 dump (ANIC); 2 ♀, 5 Apr.–23 May 1993, P. Zborowski, A. Roach, F.I.T. (ANIC); 1 ♀, 12 km SSE Heathlands, 11.51S, 142.38E, 25 Apr.–7 Jun. 1992, T. McLeod, F.I.T.#2 (WINC); 1 ♀, 15 km NEbyE Heathlands, 15–26 Jan. 1992, I. Naumann, T. Weir (ANIC); 1 ♀, 12 km SSE Heathlands 15–26 Jan. 1992, I. Naumann, T. Weir, M.T. (ANIC); 2 ♀, 12 km SSE Heathlands, 26 Jan.–25 Apr. 1992, T. McLeod, P. Feehney, M.T. (ANIC); 2 ♀, 9 km ENE Mt Tozer, 12.43S, 143.17E, 5–10 Jul. 1986, J.C. Cardale M.T. (ANIC, WINC); 1 ♀, Iron Range, Cape York Pen., 26–31 May 1971, S.R. Monteith (ANIC).

Female

Length

3.4–3.9 mm (mean 3.7 mm).

Colour

Dark brown except legs and antennal radicle yellow.

Head

Width between eyes $0.4\text{--}0.45 \times$ width of head in dorsal view; OOL 0.04 mm; LOL 0.19 mm; POL 0.27 mm; ocellar diameter 0.08–0.1 mm, $0.19\text{--}0.22 \times$ width between eyes; head with long fine brown pilosity; occiput medially smooth, rugulose laterally; posterior vertex moderately coarsely punctate; medial vertex and dorsal frons punctate; malar region with radiating striae, continuing well onto frons, grading to punctate; malar space $0.39\text{--}0.44 \times$ as long as eye height; interantennal process crenulate, with lateral carinae; clypeus moderately produced, convex between lateral points; anteclypeus narrowly defined by marginal raised smooth band; mandibles smooth, lower tooth $0.8\text{--}1.0 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, long, brown; dorsal pronotum finely punctate; latero-dorsal pronotum coarse punctate to punctate-reticulate; latero-ventral pronotum punctate-reticulate; pronotal shoulders prominent, defined by transverse carina; anterior scutum mostly smooth, sometimes with scattered fine punctures, posterior and lateral scutum with moderately fine scattered punctation; notauli usually not defined but may have rough line of punctation resembling notaular trace; scutellum punctate-reticulate laterally rugose-reticulate medially, no lateral spines defined; dorsellum moderately prominent, not emarginate; mesopleuron smooth medially, punctate laterally; mesosternum punctate; propodeum $0.35\text{--}0.42 \times$ as long as wide, punctate laterally, becoming rugose medially about medial longitudinal furrow, fine short white pilosity laterally, postero-lateral area square; indentation about nucha present.

Wings

Lightly infusate, with short fine setae; stigmal spot defined as infusate translucent area, stigmal vein spectral.

Metasoma

$2.1\text{--}2.3 \times$ as long as wide, with fine, moderately long, brown pilosity; T1 $0.44\text{--}0.57 \times$ as long as upper anterior width, $0.35\text{--}0.4 \times$ as long as lower anterior width, longitudinally striate; T2 longitudinally striate; T3 striate-reticulate, becoming rugose-reticulate medially; T4–T5 striate, becoming striate-reticulate with foveolae posteriorly; T6 punctate-reticulate; S1–5 punctate reticulate with longitudinal trend; S3–S5 smooth medially; S2 with basal transverse ridge; S2–S3 with felt fields defined.

Male

Unknown.

Distribution

Scelio anyirambo is known from numerous specimens collected at Cape York Peninsula (Fig. 8.10).

Host

Unknown.

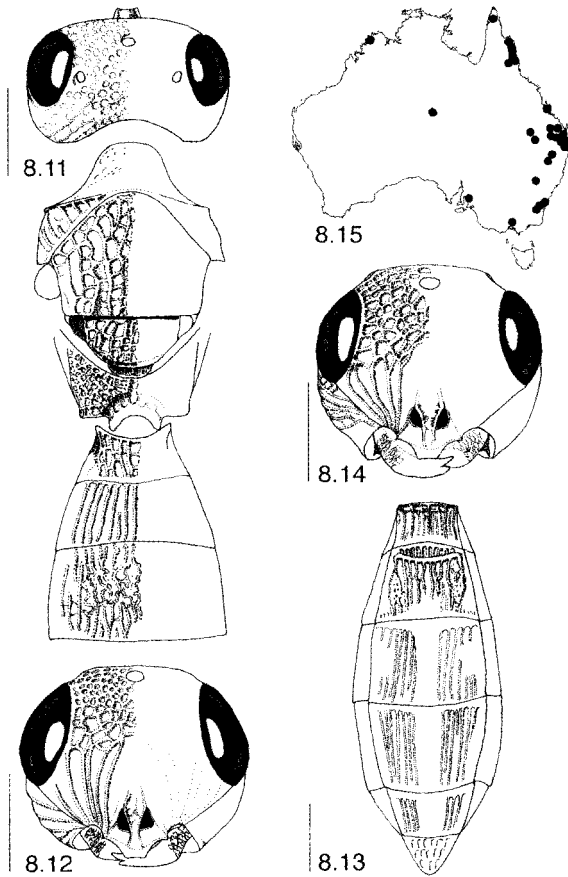
Comments

Scelio anyirambo can be separated from other Australian species by its coarse, sparse punctate sculpturing on the head and dorsal mesosoma against a largely smooth, polished background. This species is placed between *S. grbini* and *S. bronae* in the phylogenetic analysis (Fig. 6.2), in the terminal clade defined by having the upper and lower anterior widths of T1 subequal, i.e. the ratio less than 1.3:1.0. Males of this species are inferred from the analysis as lacking antennal tyloids. The name ‘anyirambo’ is derived from the aboriginal words ‘anyir’ meaning ‘from’ and ‘ambo’ meaning ‘egg’, and refers to the egg stage of the unknown host which this species parasitises.

SCELIO ASPERATUS DODD

(Figs 8.11–8.23)

Scelio asperatus Dodd, 1927: 167.- Galloway, 1976: 104; Galloway & Austin 1984: 10; Johnson, 1992: 474.



Figs 8.11–8.15. *Scelio asperatus* Dodd: **8.11.** ♀ Holotype, dorsal head to T3. **8.12.** ♀ Holotype, anterior head. **8.13.** ♀, ventral metasoma. **8.14.** ♂ Paratype, anterior head. **8.15.** Distribution map. Scale lines: 8.11–8.14, 0.25 mm.

Material examined

Holotype

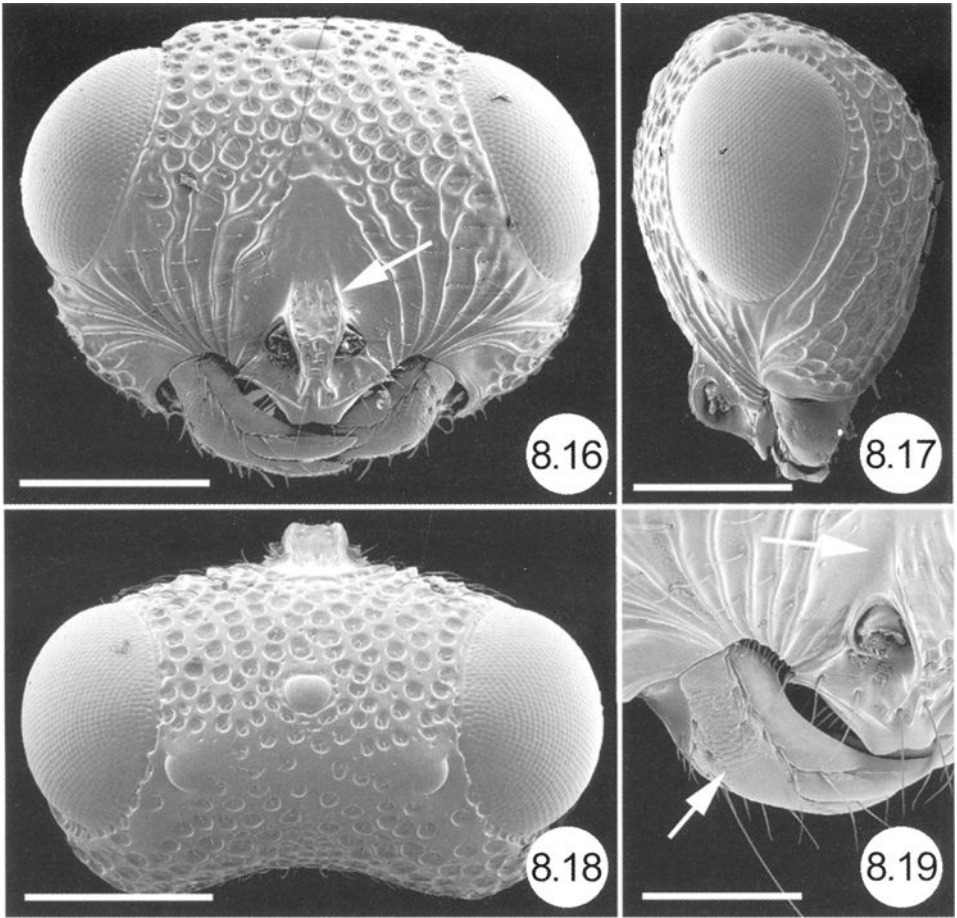
♀, Queensland, 'Brisbane Queensland A.P. Dodd' (SAMA).

Paratype

Queensland: 1 ♂, same data as holotype labelled 'Allotype' (SAMA); 1 ♂, Mt Tamborine, A.P. Dodd (QMBA). **New South Wales:** 1 ♀, Moree, Mar. 1926, A.P. Dodd (QMBA).

Other material examined

Queensland: 1 ♀, Atherton, Mar. 1921, A.P. Dodd (ANIC); 1 ♀, 3 km W Batavia Downs, 16 Feb.–8 Mar. 1993, I Cunningham, M.T. (ANIC); 11 ♂, Big Mitchell Creek, Mareeba-Molloy Road, 4 May 1967, D.H. Colless (ANIC); 1 ♀, Blackall Range, A.P. Dodd (ANIC); 1 ♀, Bribie Island, 28 Dec. 1976, Z. Boucek; 1 ♀, Koy property at Brigooda, 26.16S, 151.25E,



Figs 8.16–8.19. *Scelio asperatus* Dodd, ♀: **8.16.** Anterior head. **8.17.** Lateral head. **8.18.** dorsal head. **8.19.** Malar region and mandible, showing reticulate sculpturing on basal mandible and lateral carina of interantennal process continuing onto speculum. Scale line: 8.16–8.18, 0.25 mm; 8.19, 0.2 mm.

15 Dec. 1994–26 Jan. 1995, G.B. Monteith (QMBA); 1 ♀, nr Bowerbird Creek 9 km W Mount Molloy, 24 Apr. 1997, C.J. Burwell (QMBA); 1 ♀, Bunya Mountains, 26.51S, 151.34E, 22 Apr. 1986, B.K. Cantrell, D-vac. (ASCU); 2 ♀, Bunya Mountains, 15 Apr. 1927, A.P. Dodd (ANIC); 1 ♂, 41 km N Charleville, Warrego River, 16 May 1991, E.C. Dahms, G. Sarnes (QMBA); 1 ♀, 10.2 km SE Chillagoe on road to Mareeba, 17.32S, 144.33E, 2 May 1992, E.C. Dahms, G. Sarnes (QMBA); 4 ♀, 3 ♂, Chinchilla, Jan. 1926, Jan. 1927 & Nov. 1926, A.P. Dodd (ANIC); 1 ♂, Forest Road, near Ingham, 20 Mar. 1961, R. Straatman (ANIC); 1 ♀, 1 ♂, Gogango, 5 Jun. 1929 and Dec. 1929, A.P. Dodd (ANIC); 3 ♀, Goondiwindi, Oct. 1928 & Jan. 1929, A.P. Dodd (ANIC); 1 ♀, 2 ♂, 14 km WbyN Hope Vale Mission, 15.16S, 144.39E, 8–10 Oct. 1980 & 7–10 May 1981, I.D. Naumann (ANIC); 5 ♀, 1 ♂, Indooroopilly site, 10–17 Dec. 1984, M.T. (ASCU); 2 ♀, Indooroopilly, Dec. 1976, Z. Boucek, M.T. (ASCU); 1 ♀, Kirrama Barracks, Kirrama State Forest, 18.12S, 145.45E, 4 Apr. 1996, C.J. Burwell (QMBA); 1 ♀, 15 km NE Mareeba, 20 Dec. 1984–7 Jan. 1985, Storey and Titmarsh (ASCU); 11 ♀, Morven, A.P. Dodd (ANIC); 1 ♂, Mt Glorious State Forest, 28 Feb.–9 Mar. 1984, L. Masner, M.T. (CNCI); 2 ♀, 4 ♂, Mt Tamborine, A.P. Dodd (ANIC); 3 ♀, 16 km up Davies Creek Rd via Mareeba, 14 Mar.–12 Apr. 1983, Storey, Titmarsh (1 WINC, 2 ASCU);

1 ♀, Wongabel State Forest 6 km S Atherton, 9 Jan.–10 Feb. 1984, Storey and Brown, M.T. (ASCU); 4 ♀, Westwood, Oct. & Dec. 1927 & Feb. 1928 A.P. Dodd (ANIC). **New South Wales:** 2 ♂, 5 km NE Nerriga, 24 Jan.–4 Feb. 1984, L. Masner, M.T. (CNCI); 1 ♀, Trangie research station, 28 Nov. 1979, Aerial Netting (WINC); 1 ♀, Mt Lindesay State Forest via Woodenbong, 10 Nov. 1974, I. Naumann (ASCU). **Australian Capital Territory:** 6 ♀, 2 ♂, Black Mountain, Jan. 1982, I.D. Naumann, J.C. Cardale, M.E. Matthews, M.T. (ANIC); 1 ♂, Mount Gingera, 4 Feb. 1965, D.H. Colless (ANIC); 1 ♀, 1 ♂, Piccadilly Circus, 35.22S, 148.48E, Mar. 1984, J. Lawrence, T. Weir, M-L. Johnson (ANIC). **Victoria:** 2 ♀, 1 ♂, Belgrave, Dec. 1926, A.P. Dodd (ANIC). **South Australia:** 1 ♀, Mt Barker Summit, 18 Jan.–2 Feb. 1996, M. Iqbal and A.D. Austin, P.T. (WINC). **Western Australia:** 1 ♂, Mining Camp Mitchell Plateau, 9–19 May 1983, I.D. Naumann, J.C. Cardale (ANIC). **Northern Territory:** 1 ♀, 1 ♂, 30 km NWbyW Alice Springs, 7 Oct. 1978, J.C. Cardale.

Female

Length

3.6–5.4 mm (mean 4.7 mm).

Colour

Head, apical antenna and mesosoma dark brown, metasoma, basal antenna and mandible medium brown, legs and palps yellow.

Head

Width between eyes $0.49\text{--}0.55 \times$ width of head in dorsal view; OOL $0.4\text{--}0.6$ mm; LOL $0.21\text{--}0.25$ mm; POL $0.36\text{--}0.46$ mm; ocellar diameter $0.06\text{--}0.1$ mm, $0.13\text{--}0.15 \times$ width between eyes; head with fine, short, sparse translucent pilosity; occiput rugulose, with medial longitudinal trend; posterior vertex rugulose reticulate; medial vertex punctate-reticulate, with smooth patches between ocelli; dorsal frons with broad shallow rounded punctation; ventral frons grading from punctate to rugulose reticulate to longitudinally striate about medial smooth patch; malar region with well-defined, radiating striae continuing halfway up frons; malar space $0.48\text{--}0.6 \times$ as long as eye height; interantennal process long and narrow ventrally, with lateral carinae continuing onto speculum; clypeus well produced between lateral points, with margin narrow and straight to slightly concave medially; anteclypeus defined by raised smooth area; mandibles with basal reticulate sculpturing, lower tooth $0.33\text{--}0.71 \times$ upper tooth, dorsal tooth absent.

Mesosoma

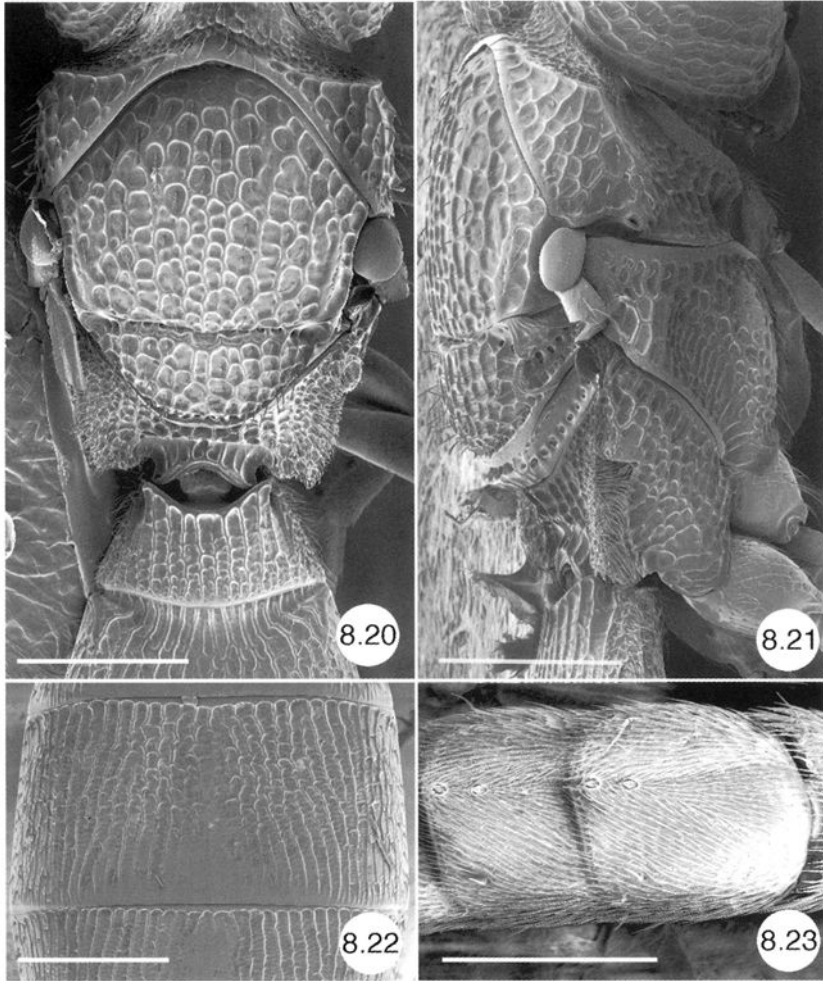
Pilosity fine, moderately long, sparse, translucent; dorsal pronotum sparsely rugulose; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum rugose-reticulate; pronotal shoulders prominent, defined by transverse carina; scutum rugose-reticulate, with broad rectangular pits; notauli poorly defined amongst sculpturing; scutellum rugose-reticulate, no lateral spines defined; dorsellum prominent, not emarginate; mesopleuron longitudinally strigose; mesosternum irregularly punctate; propodeum $0.33\text{--}0.5 \times$ as long as wide, rugulose-reticulate, medial longitudinal furrow usually absent, with sparse white lateral pilosity, postero-lateral area square; indentation about nucha absent.

Wings

Lightly infusate, with fine light setae; stigmal spot poorly defined as slight infuscation, stigmal vein long.

Metasoma

$2.55\text{--}3.0 \times$ as long as wide; with fine, short lateral pilosity; T1 $0.62\text{--}0.92 \times$ as long as upper anterior width, $0.56\text{--}0.92 \times$ as long as lower anterior width, lower anterior width subequal



Figs 8.20–8.23. *Scelio asperatus* Dodd, ♀: **8.20.** Dorsal pronotum to T2. **8.21.** Lateral mesosoma. **8.22.** Dorsal T3. **8.23.** Antennal segments, showing basiconic sensilla and directed pilosity. Scale lines: 8.20, 8.21, 0.5 mm; 8.22, 0.4 mm; 8.23, 0.1 mm.

to upper anterior width, longitudinally strigose; T2 longitudinally striate; T3 rugulose-reticulate medially; T4–T5 longitudinally striate with medial smooth area; T6 rugulose; S1 longitudinally strigose; S2 rugulose basally, striate laterally, smooth apico-medially, with shallow basal transverse ridge; S3–S5 with fine longitudinal striation laterally and smooth longitudinal area medially; S2–S3 with low felt fields defined.

Male

As for female, except tyloid clearly defined on antennal segment 5.

Distribution

Scelio asperatus is commonly collected in eastern Australia from Melbourne to Cape York, but has also been taken from the central and north-western parts of the continent (Fig. 8.15).

Host

Unknown.

Comments

Scelio asperatus is the sister taxon to *Sceliocerdo* + *S. nanocuspis*, which along with *S. littoralis* are united by having the interantennal process carinate and extending onto the speculum (Fig. 6.2). These four species plus *S. matthewsi* form a group defined by a character reversal, i.e. having a striate mesopleuron. *S. asperatus* is similar to *S. bipartitus* and *S. orientalis* because of the form of the propodeum and the reticulate sculpturing of the basal mandible. However, *S. asperatus* can be easily distinguished from these species by the sculpturing of the mesosternum, the broad basal mandible, and the long narrow clypeus, which has a straight margin medially.

SCELIO AUSTRALIENSIS KIEFFER

Scelio australiensis Kieffer, 1905: 100.- Kieffer, 1908: 128; Kieffer, 1926: 313; Dodd, 1927: 137; Galloway, 1976: 105; Galloway & Austin 1984: 10; Johnson, 1992: 480.

Comments

The female holotype of this species was collected at Mt Victoria, New South Wales, and was apparently deposited in HNHM by Kieffer. However, we have not been able to locate the type, nor were Dodd (1927) or Galloway (1976) able to examine it as part of their studies. The original description is not detailed enough to allow it to be compared with any other species, and it has not been included in the key. The status of *S. australiensis* will therefore remain unclear until the holotype is found.

SCELIO BIPARTITUS KIEFFER

(Figs 8.24–8.27)

Scelio bipartitus Kieffer, 1907: 296.- Kieffer, 1926: 339; Dodd, 1927: 164; Masner 1965: 92; Galloway, 1976: 104; Galloway & Austin 1984: 10; Johnson, 1992: 475.

Scelio affinis Dodd, 1914b: 114.- Kieffer, 1926: 342; Tillyard, 1926: 283; Dodd, 1927: 164 (synonymised with *S. bipartitus*); Galloway, 1976: 104.

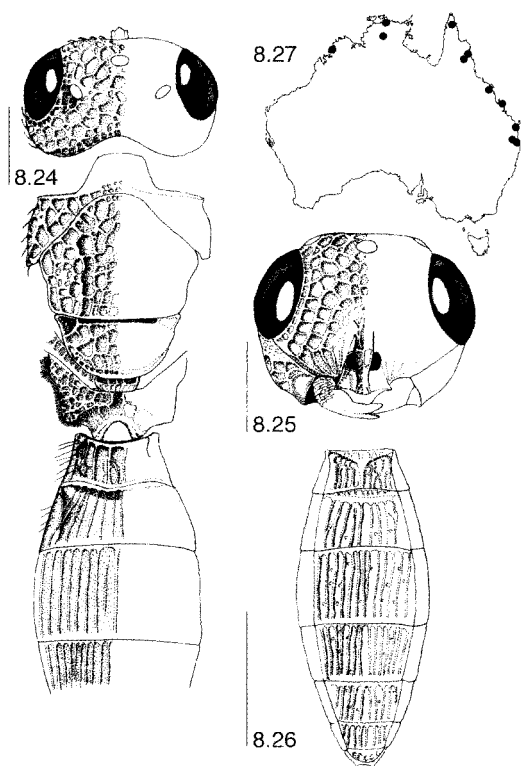
Material examined

Holotypes

♂ (*S. bipartitus*), Queensland, 'Mackay 4. 00', 'Queensland R.E. Turner 1907–94' (BMNH);
♂ (*S. affinis*), Queensland, without data label (SAMA).

Other material examined

Queensland: 4♂, 3 km W and 4 km NE Batavia Downs, 12.40S, 142.39E, 11 Dec. 1992–17 Jan. 1993, P. Zborowski, M.T. (ANIC); 3♂, Brisbane, Indooroopilly DPI, Feb. 1978, M.T. (QDPC); 1♂, 1–6 km SE Chillagoe, on Rd to Mareeba, 3 Apr. 1992, E.C. Dahms, G. Sarnes (QMBA); 1♂, Cooloolo, near camp Milo, 23 Apr. 1981, E.C. Dahms (QMBA); 2♂, Emmett Ck, 10 km NW Giru, 11 May 1980, I.D. Naumann, J.C. Cardale (ANIC); 6♂, Gatton, DPI Research Station, 9–16 Mar. 1981, M.T. (QDPC); 1♂, Gatton, 25 May 1981, D-vac in potato crop (QDPC); 1♂, Stock camp, 15 km E Kowanyama, 13 Jan. 1977, D.L. Hancock (QMBA); 1♂, 3 km W Mt Molloy, 30 Jan. 1982, J.F. Donaldson, D-vac (QDPC); 1♂, Rosevale area, 16 Mar. 1975, B.K. Cantrell (QDPC); 1♂, Samford, 19 Nov. 1960, M Day, N. Grylls (ANIC); 1♂, Samford, 12 Jan. 1962, R Lindsay (ANIC); 1♂, Tarome area, 16 Mar. 1975, B.K. Cantrell (QDPC); 1♂, 23 km N Yeppoon, 31 Oct. 1975, I.D. Galloway, D-vac (QDPC). **Western Australia:** 1♂, Mitchell Plateau mining camp, 14.49S, 125.05E, 9–19 May 1983, I.D. Naumann, J.C. Cardale M.T. (ANIC). **Northern Territory:** 1♂, Black Point, Coburg Pen., 11.09S, 132.09E, 31 Jan. 1977, E.D. Edwards



Figs 8.24–8.27. *Scelio bipartitus* Kieffer:
 8.24. ♂ Holotype, dorsal head to T4. 8.25. ♂
 Holotype, anterior head. 8.26. ♂ Holotype,
 ventral metasoma. 8.27. Distribution map.
 Scale lines: 8.24–8.26, 0.25 mm.

(ANIC); 1♂, Cooper Creek, 19 km EbyS Mt Borradaile, 5 Jun. 1973, D.H. Colless (ANIC); 5♂, Fergusson R., 31 km SEbyS Pine Creek, 14.04S, 131.59E, 14. Nov. 1979, I.D. Naumann (ANIC).

Male

Length

3.5–4.1 mm (mean 3.8 mm).

Colour

Dark brown or black except legs, antenna and mandibles yellow.

Head

Width between eyes $0.53\text{--}0.56 \times$ width of head in dorsal view; OOL $0.03\text{--}0.06$ mm; LOL $0.18\text{--}0.23$ mm; POL $0.25\text{--}0.4$ mm; ocellar diameter $0.08\text{--}0.1$ mm, $0.15\text{--}0.18 \times$ width between eyes; head with long, fine translucent pilosity, slightly coarser on temples and ventral vertex; occiput finely punctate; posterior vertex coarsely punctate-reticulate, becoming finer medially; medial vertex and dorsal frons punctate-reticulate; ventral frons reticulate; malar region with short radiating carinae, becoming reticulate dorsally; malar space $0.49\text{--}0.58 \times$ as long as eye height; interantennal process long narrow and crenulate between lateral carinae, which continue onto speculum; clypeus well produced between lateral points; anteclypeus long, defined by raised smooth area; mandibles narrow at base, with reticulate pattern in basal three quarters, lower tooth $0.5\text{--}0.8 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity long, translucent, moderately coarse, slightly coarser on lateral pronotum; dorsal pronotum virtually smooth; latero-dorsal pronotum coarsely reticulate-punctate; latero-ventral pronotum finely punctate to reticulate-punctate; pronotal shoulder prominent; pilosity moderately fine; anterior scutum punctate, posterior scutum punctate-reticulate, lateral scutum punctate; notauli partly defined amongst sculpturing; scutellum punctate-reticulate, no lateral spines defined; dorsellum moderately prominent, not emarginate; mesopleuron finely punctate; mesosternum reticulate-punctate; propodeum $0.48\text{--}0.51 \times$ as long as wide, punctate-reticulate, medial longitudinal furrow defined anteriorly, with dense fine pilosity laterally, postero-lateral area square; indentation about nucha absent.

Wings

Lightly infuscate, with fine short setae; stigmal spot translucent, weakly defined; stigmal vein well defined.

Metasoma

$2.5\text{--}2.82 \times$ as long as wide, with fine, sparse, long pilosity laterally; T1 $0.69\text{--}0.86 \times$ as long as upper anterior width, $0.55\text{--}0.63 \times$ as long as lower anterior width, with coarse longitudinal striae and background crenulation; T2 longitudinally striate, with smooth medio-posterior patch; T3–T5 striate; T6 strigose; S1–S5 evenly striate; S2 with basal transverse carina; S2 and S3 with weak felt fields defined.

Female

Unknown.

Distribution

This species is broadly distributed across northern Australia, extending down the east coast to Brisbane (Fig. 8.27).

Host

Unknown.

Comments

Scelio australis has previously been treated as a junior synonym of *S. bipartitus* (Dodd 1927; Johnson 1992), but in fact it represents a different species and is here placed as a junior synonym of *S. gobar*. The holotypes of *S. gobar* and *S. australis* are clearly different from *S. bipartitus* and can be separated by the form of the propodeum, viz. *S. bipartitus* lacks indentations on the apical propodeum either side of the nucha. Because *S. australis* has been treated as *S. bipartitus* for the last 70 years, previous reference to the latter name should be regarded with scepticism, given that specimens of *S. gobar* (= *S. australis*, *S. froggatti* and *S. ovi*) are more common in collections. With the change in status of *S. australis* proposed here, *S. bipartitus* is now only known from the male sex.

Scelio bipartitus is similar to *S. orientalis*, *S. asperatus* and *S. littoralis*, based on the reticulate sculpturing of the basal mandible and the apical propodeum not being indented about the nucha. *Scelio bipartitus* can be distinguished from *S. orientalis* by the presence of carinae extending from the interantennal process onto the frons, and from *S. asperatus* and *S. littoralis* by S3 being evenly longitudinally striate throughout, and the mandible narrow and yellow in colour. As it is only known from male specimens it has not been included in the phylogenetic analysis.

SCELIO BORROLOOLENSIS DANGERFIELD & AUSTIN SP. NOV.

(Fig. 8.29)

Material examined*Holotype*

♀, Northern Territory, '16.28S, 136.09E 46 km SSW of Borroloola NT 23 Apr. 1976 D.H. Colless' (ANIC).

Female*Length*

4.8 mm.

Colour

Head black, mesosoma reddish brown, metasoma and legs orange.

Head

Width between eyes $0.58 \times$ width of head in dorsal view; OOL 0.03 mm; LOL 0.38 mm; POL 0.61 mm; ocellar diameter 0.08 mm, $0.1 \times$ width between eyes; head with coarse, dense, long, white, blunt-tipped pilosity, even coarser on temples; occiput finely rugulose; posterior and medial vertex with moderately coarse punctate-reticulation; malar region and frons, with long well-defined radiating striae, becoming slightly strigose on dorsal frons; speculum not smooth, with radiating longitudinal striae from malar region; malar space $0.52 \times$ as long as eye height; interantennal process with lateral carinae continuing around antennal sockets, not onto frons; clypeus produced between lateral points, with medial edge straight; anteclypeus defined by raised smooth marginal area; mandibles smooth and shiny, lower tooth $0.86 \times$ upper tooth, dorsal tooth present.

Mesosoma

Pilosity fine on dorsal pronotum, coarse white blunt-tipped on lateral pronotum, coarse with orange tinge on medial scutellum; dorsal pronotum irregularly carinate and finely punctate, latero-dorsal pronotum punctate-reticulate; latero-ventral pronotum smooth in anterior two-thirds, becoming rugose-reticulate posteriorly; pronotal shoulders prominent defined by transverse carina; scutum rugose-reticulate; notauli poorly defined; scutellum rugose-reticulate, no lateral spines defined; dorsellum prominent, with broad shallow emargination; mesopleuron rugulose-reticulate; mesosternum with coarse punctate-reticulation; propodeum $0.4 \times$ as long as wide, rugose-reticulate about smooth furrow around arching nucha, with fine long dense white pilosity postero-laterally, postero-lateral area rounded; indentation about nucha absent.

Wings

Lightly infusate, with short dark setae; stigmal spot defined by light infuscation with short lightly infusate stigmal vein.

Metasoma

$1.95 \times$ as long as wide, with coarse white moderately sparse pilosity laterally; T1 $0.58 \times$ as long as upper anterior width, $0.49 \times$ as long as lower anterior width, longitudinally strigose with background reticulation; T2–T5 longitudinally strigose; T6 rugose-reticulate; S1–S5 rugose-reticulate, S2 with shallow basal transverse ridge; S2–S3 with low felt fields defined.

Male

Unknown.

Distribution

This species is known only from the holotype collected at Borrooloola on the Gulf of Carpentaria, Northern Territory (Fig. 8.29).

Host

Unknown.

Comments

This species belongs to a monophyletic group containing *S. pilosus*, *S. locustae* and *S. setafascis*, all of which possess a dorsal mandibular tooth, an unequivocal synapomorphy (Fig. 6.2). This group of species is most basal within the clade defined by having the upper and lower anterior widths of T1 subequal, i.e. the ratio less than 1.3:1.0. Males of this species are inferred from the phylogenetic analysis as lacking antennal tyloids. *Scelio borrooloolensis* is named after the type locality.

SCELIO BRONAE DANGERFIELD & AUSTIN SP. NOV.

(Figs 8.28, 8.29)

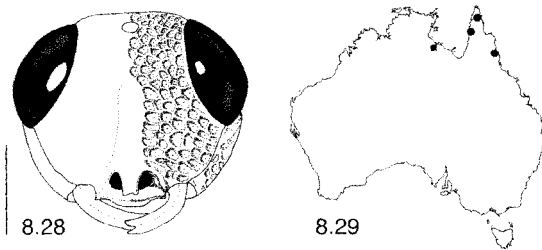


Fig. 8.28. *Scelio bronae* sp. nov. ♀ Holotype, anterior head.

Fig. 8.29. Distribution map for ● *S. bronae* and ■ *S. borrooloolensis* sp. nov. Scale line: 8.28, 0.25 mm.

Material examined

Holotype

♀, Queensland, '12.04S 142.39E QLD 3 km W Batavia Downs 23 Aug.–16 Sep. 1992 Malaise Trap P. Zborowski & L. Miller' (ANIC).

Paratype

Queensland: 1 ♀, Aurukun, 19 May 1983, J.F. Donaldson (QDPC); 1 ♀, 4 km NE Batavia Downs, 12.39S, 142.42E, 11 Dec. 1992–17 Jan. 1993, P. Zborowski, M.T. (ANIC); 1 ♀, Mareeba, 28 Dec. 1986, H. & A. Howden (CNCI).

Female

Length

2.8–3.2 mm (mean 3.0 mm).

Colour

Orange to yellow except head, scutellum, dorsellum, T2–T7 and antennal clava brown to black.

Head

Width between eyes $0.53 \times$ width of head in dorsal view; OOL 0.05 mm; LOL 0.16 mm; POL 0.26 mm; ocellar diameter 0.06 mm, $0.15 \times$ width between eyes; head with pilosity mostly fine, slightly coarser on temples; occiput virtually smooth, with fine punctation; posterior vertex rugose-reticulate; medial vertex and frons punctate-reticulate; malar region rugose-reticulate to punctate-reticulate; malar space $0.47 \times$ as long as eye height; inter-antennal process virtually smooth, with moderately developed lateral carinae; clypeus moderately produced and convex between lateral points; anteclypeus defined by moderately broad smooth raised area; mandibles smooth, lower tooth $1.0\text{--}1.1 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, slightly coarser on lateral pronotum; dorsal pronotum virtually smooth with scattered punctation; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum smooth anteriorly to rugose-reticulate posteriorly; pronotal shoulders poorly defined by rugosity, no transverse carina present; scutum rugose-reticulate; notauli poorly defined amongst sculpturing; scutellum rugose-reticulate, no lateral spines defined; dorsellum prominent, margin straight to only very slightly emarginate; mesopleuron punctate-reticulate; mesosternum punctate; propodeum $0.5 \times$ as long as wide, rugulose laterally to rugose medially about medial longitudinal furrow, with sparse fine long pilosity laterally, postero-lateral area square; indentation about nucha present.

Wings

Lightly infusate, with short, fine setae; stigmal spot light opaque with infusate stigmal vein.

Metasoma

$2.2 \times$ as long as wide; pilosity fine; T1 $0.55 \times$ as long as upper anterior width, $0.44 \times$ as long as lower anterior width, longitudinally striate; T2 longitudinally striate-reticulate; T3–T4 rugose-reticulate medially, becoming striate-reticulate laterally; T5 longitudinally striate; T6 punctate-reticulate; S1–5 rugose-reticulate with scattered foveolae; S4–S5 becoming strigose medially; S2 with very shallow basal transverse ridge and poorly defined felt nodes.

Male

Unknown.

Distribution

Scelio bronae is known only from Mareeba and Batavia Downs in the northern part of Cape York (Fig. 8.29).

Host

Unknown.

Comments

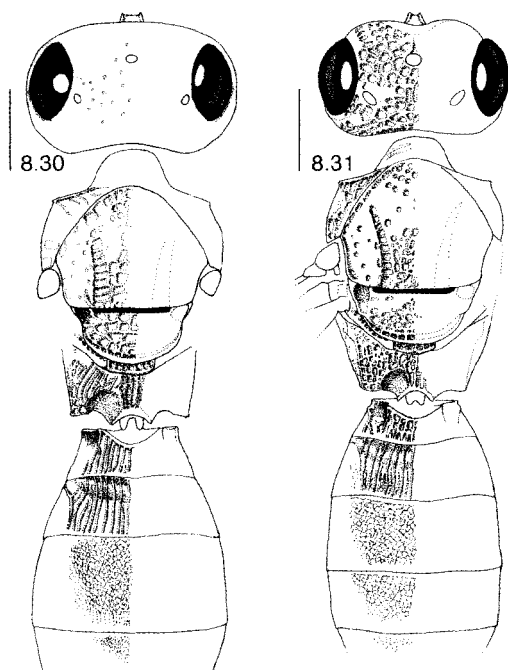
This species comes out between *S. annae* and *S. anyirambo* in the phylogenetic analysis (Fig. 6.2) and is part of the clade defined by having the upper and lower anterior widths of T1 subequal, i.e. the ratio less than 1.3:1.0. It is superficially similar to *S. nigriscutellum* and differs from it by the absence of an emarginate dorsellum and having a distinctly rugose-reticulate malar region. It is named after Bronwen Jane Mayo.

SCELIO CHORTOICETES FROGGATT

(Figs 8.30–8.53)

Scelio chortoicetes Froggatt, 1910: 35.- Dodd, 1913a: 135; Kieffer, 1926: 343; Tillyard, 1926: 283; Dodd, 1927: 143; Galloway, 1976: 104; Galloway & Austin 1984: 10; Johnson, 1992: 476.

Scelio pulchellus Crawford, 1911: 268.- Dodd, 1913a: 135; Kieffer, 1926: 337; Masner and Muesebeck, 1968: 45.



Figs 8.30, 8.31. *Scelio chortoicetes* Froggatt: 8.30. ♀ Holotype, dorsal head to T4. 8.31. ♂, dorsal head to T5. Scale lines: 0.25 mm.

Material examined

Holotypes

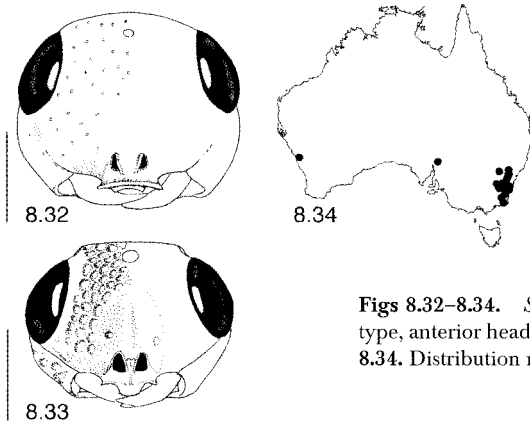
♀ (*S. chortoicetes*), New South Wales, 'N. S. Wales, Lake Cowal, Robertson, Parasite locust eggs 190' 'W.W. Froggatt Collection' (ASCU); ♀ (*S. pulchellus*) (USNM).

Paratype

New South Wales: ♀ (*S. chortoicetes*), same data as holotype, parasite eggs of small plague locust, 1901' (ASCU).

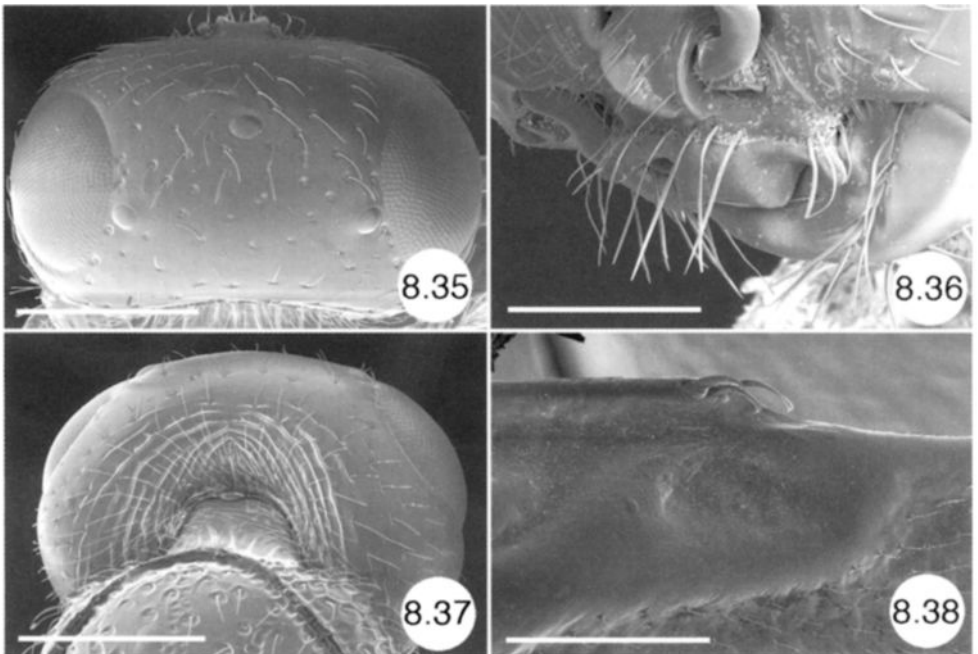
Other material examined.

New South Wales: 74 ♀, 14 ♂, Bombala, 21 Jan. 1982 and 1983, G. Baker (ASCU); 7 ♀, 12 ♂, Braidwood, 22 Dec. 1980, R.A. Farrow (ASCU); 26 ♀, 8 ♂, Mila, 21 Jan. 1983, G. Baker, collected on wing in area infested with *Phaulacridium vitatum* and *Austroicetes pusilla* (ASCU); 9 ♀, 2 ♀, Cathcart, 21 Jan. 1982, G. Baker (ASCU); 1 ♀, Cooma, 27 Jan. 1982, G. Baker (ASCU); 1 ♀, Tarago, 11 Jan. 1982, G. Baker (ASCU); 1 ♀, Eucumbene, 20 Jan. 1982, G. Baker (ASCU); 1 ♀, Dalgety, 9 Feb. 1983, G. Baker (NWSA); 1 ♀, Chakola, 12 Jan. 1982, G. Baker (ASCU); 1 ♀, Oberon, 9 Feb. 1982, G. Baker (ASCU); 1 ♀, 1 ♂, Captains Flat,

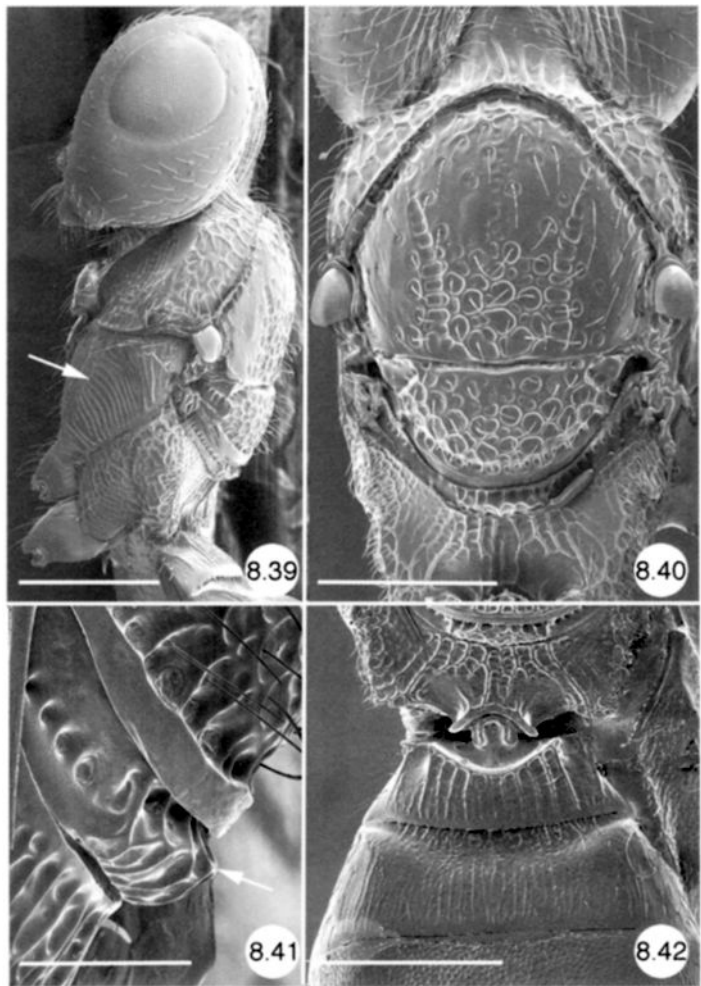


Figs 8.32–8.34. *Scelio chortoicetes* Froggatt: **8.32.** ♀ Holo-type, anterior head. **8.33.** from Bombala NSW, anterior head. **8.34.** Distribution map. Scale lines: 0.25 mm.

26 Jan. 1982, G. Baker (ASCU); 2 ♀, Queanbeyan, 18 Jan. 1983, G. Baker (ASCU); 1 ♀, Goulburn, 13 Feb. 1955, E.F. Riek (ANIC). **Australian Capital Territory:** 22 ♀, 5 ♂, Black Mountain, Jun.–Dec. 1931, A.L. Tonnoir or L. Graham, bred from Grasshopper eggs; 1 ♀, Blundells 30 Jan. 1930, L.F. Graham. **South Australia:** 1 ♀, Wilmington, Nov. 1958, 'reared from eggs of cruciata' (ANIC). **Western Australia:** 1 ♀, 1 ♂ (damaged), Bindi Bindi, 1 Nov. 1939, C.F.H. Jenkins, from eggs of *Austroicetes cruciata* (ANIC); 1 ♂, 6 km E Yellowdine, 31.18S,



Figs 8.35–8.38. *Scelio chortoicetes* Froggatt, ♀: **8.35.** Dorsal head. **8.36.** Antero-lateral malar region. **8.37.** Posterior head showing occipital sculpturing. **8.38.** Detail of hind wing. Scale lines: 8.35, 8.37, 0.4 mm; 8.36, 0.2 mm; 8.38, 0.1 mm.



Figs 8.39–8.42. *Scelio chortoicetes* Froggatt, ♀: **8.39.** Lateral head to T1 with mesopleuron sculpturing arrowed. **8.40.** Dorsal mesosoma. **8.41.** Lateral dorsellum, with raised prominence arrowed. **8.42.** Dorsal propodeum to anterior T3. Scale lines: 8.39, 0.5 mm; 8.40, 8.42, 0.4 mm; 8.41, 0.1 mm.

119.44E, 10 Oct. 1981, I.D. Naumann, J.C. Cardale (ANIC). **Unknown locality:** 1 ♀, from eggs of *Gastrimargus musicus*, Dec. 1938 (ANIC); 1 ♀, bred from grasshopper eggs, 1 Oct. 1931 (ANIC).

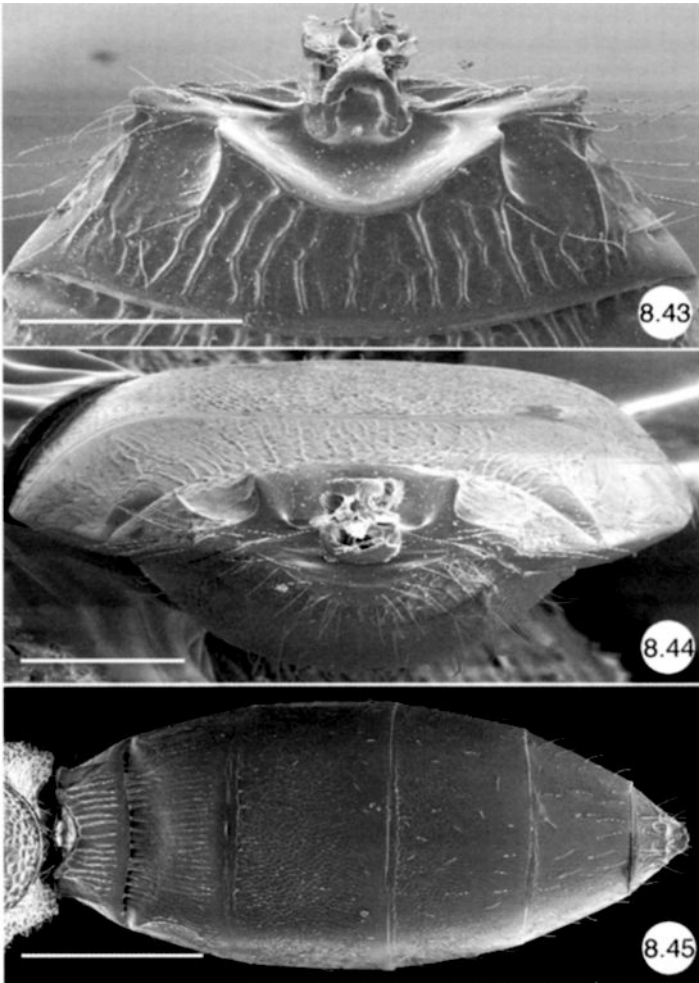
Female

Length

3.5–3.9 mm (mean 3.64 mm).

Colour

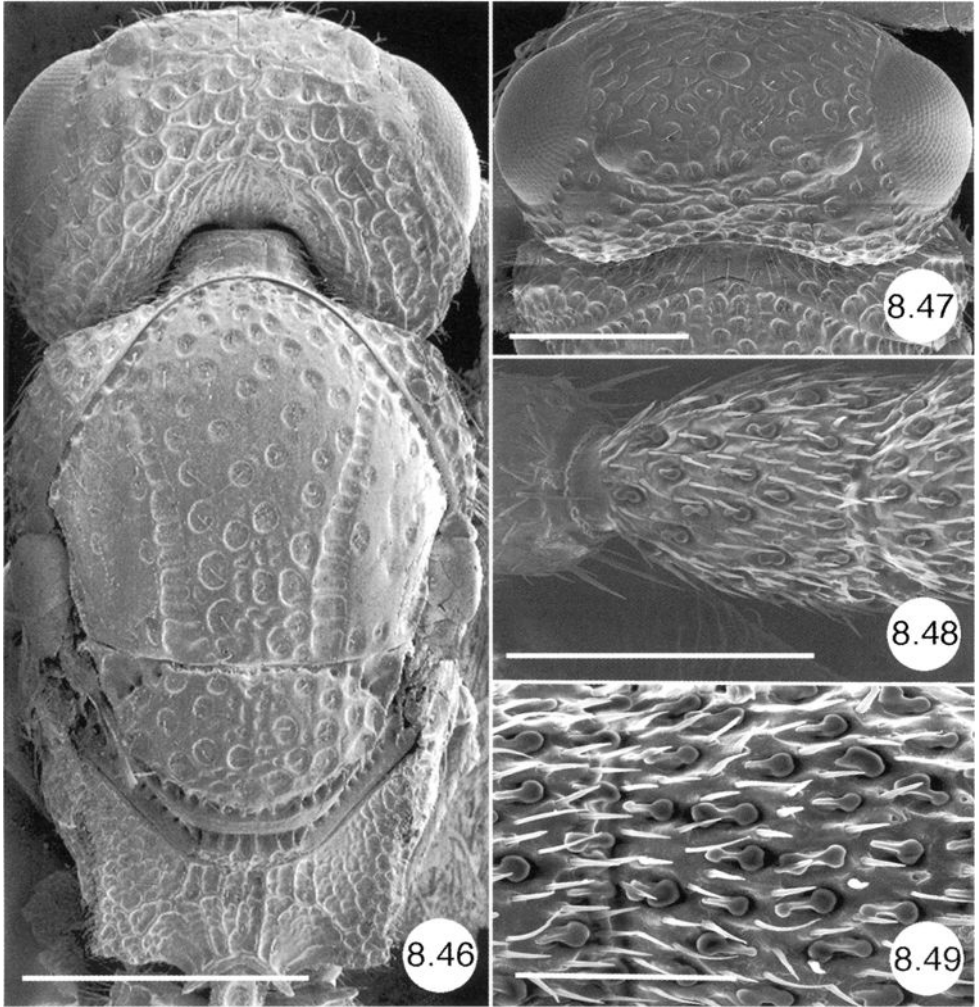
Medium brown except legs, scape, pedicel, mandibles and palps yellow to light brown.



Figs 8.43–8.45. *Scelio chortoicetes* Froggatt, ♀: 8.43. Dorsal T1. 8.44. Anterior metasoma. 8.45. Dorsal metasoma. Scale lines: 8.43, 8.44, 0.2 mm; 8.45, 0.5 mm.

Head

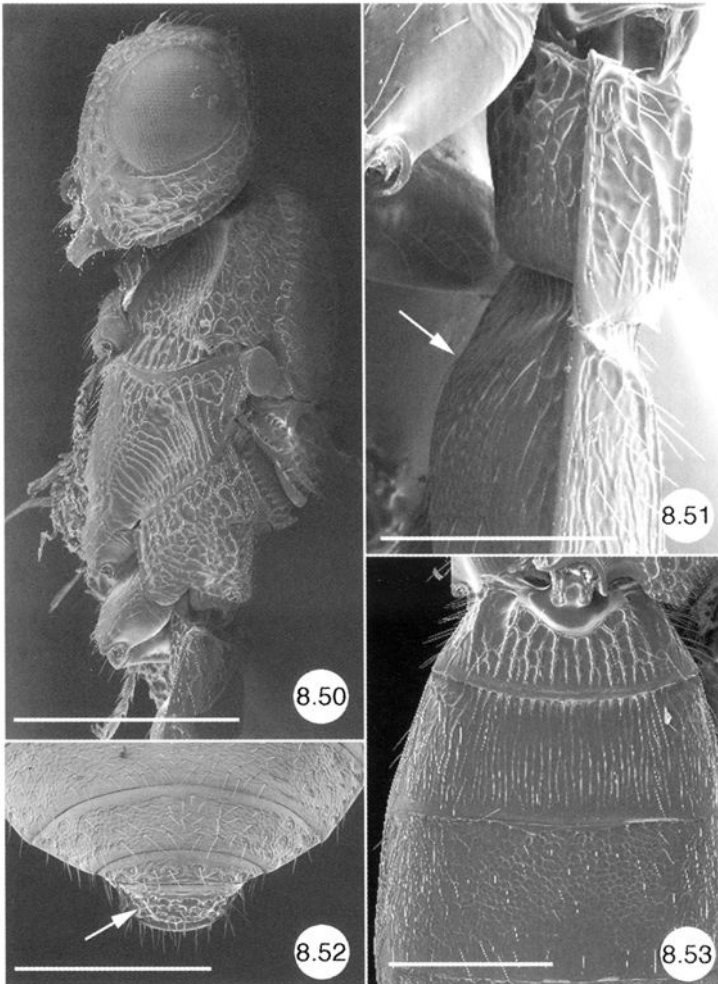
Width between eyes $0.55\text{--}0.58 \times$ width of head in dorsal view; temples mostly visible postero-laterally behind eyes in dorsal view; OOL $0.01\text{--}0.03$ mm; LOL $0.26\text{--}0.29$ mm; POL $0.43\text{--}0.47$ mm; ocellar diameter 0.06 mm, $0.11\text{--}0.12 \times$ width between eyes; head with sparse, fine, moderately short pilosity; occiput rugulose, with well-defined occipital carina; vertex and frons smooth and shiny, with sparse fine punctation; malar region with short faint radiating striae; malar space $0.71\text{--}0.88 \times$ as long as eye height; interantennal process short, broad and smooth, with prominent lateral carina continuing around antennal sockets; clypeus only slightly produced between large lateral points, medial margin concave to straight; anteclypeus defined by raised marginal area; mandibles smooth, tapering to one tooth at apex, dorsal tooth absent (i.e. unidentate).



Figs 8.46–8.49. *Scelio chortoicetes* Froggatt, ♂: 8.46. Dorsal head and mesosoma. 8.47. Dorsal head. 8.48. Antennal segment 5. 8.49. Specialised sensilla on antennal segments. Scale lines: 8.46, 0.5 mm; 8.47, 0.4 mm; 8.48, 0.1 mm; 8.49, 10 μ m.

Mesosoma

Pilosity moderate to fine, long, translucent; dorsal pronotum smooth; latero-dorsal pronotum partly rugulose; latero-ventral pronotum strigose to rugulose; pronotal shoulders prominent defined by transverse carina; anterior scutum with sparse broad shallow punctation, posterior scutum punctate-reticulate to rugulose-reticulate, lateral scutum smooth with scattered fine punctation; notauli defined by broad crenulate furrow; scutellum rugose-reticulate, no lateral spines defined; dorsellum only slightly raised above rest of metanotum, not emarginate; mesopleuron longitudinally strigose to striate; mesosternum smooth; propodeum 0.33–0.44 $\times$ as long as wide, longitudinally striate medially, obliquely striate laterally, medial longitudinal furrow absent, with sparse pilosity laterally, postero-lateral area obliquely square; indentation about nucha shallow and broad.



Figs 8.50–8.53. *Scelio chortoicetes* Froggatt, ♂: **8.50.** Lateral head and mesosoma. **8.51.** Antero-lateral metasoma, showing basal S2 without transverse ridge (arrowed). **8.52.** Apical metasoma, with S7 arrowed. **8.53.** Antero-dorsal metasoma. Scale lines: 8.50, 0.5 mm; 8.51–8.53, 0.4 mm.

Wings

Lightly infuscate in apical half, with fine short setae; stigmal spot defined as translucent or slightly infuscate rounded area either without stigmal vein, or with stigmal vein defined by infuscation.

Metasoma

1.8–2.0 × as long as wide, with sparse fine pilosity; T1 0.37–0.55 × as long as upper anterior width, 0.25–0.35 × as long as lower anterior width, longitudinally striate; T2 mostly longitudinally strigose, sometimes finely reticulate; T3–T4 finely reticulate, T5 mostly smooth; T6 finely reticulate; S1–S2 longitudinally striate, S2 smooth apically; S3–S5 smooth medially, finely reticulate laterally; S6 punctate; S2 with basal transverse furrow; S2–S3 without felt lines or nodes defined.

Male

Length

3.4–3.6 mm (mean 3.45 mm).

Colour

Dark brown except mandibles, tibia and tarsi medium brown.

Head

Width between eyes $0.59\text{--}0.62 \times$ width of head in dorsal view; OOL $0.03\text{--}0.04$ mm; LOL $0.23\text{--}0.24$ mm; POL $0.36\text{--}0.4$ mm; ocellar diameter $0.08\text{--}0.09$ mm, $0.13\text{--}0.16 \times$ width between eyes; head with fine, long, translucent pilosity; occiput finely rugulose with longitudinal trend; posterior vertex rugose-reticulate; medial vertex punctate-reticulate; frons punctate-reticulate; malar region with very short radiating striae ventrally, becoming punctate-reticulate dorsally; malar space $0.57\text{--}0.66 \times$ as long as eye height; interantennal process narrow ventrally, slightly crenulate with lateral carina continuing around antennal socket not onto frons; clypeus moderately prominent between large lateral points; anteclypeus defined by broad, raised, smooth marginal area; mandibles smooth, lower tooth $0.33\text{--}0.4 \times$ upper tooth, dorsal tooth absent; antennal segment 5 of similar size to 4 and 6, without tyloid.

Mesosoma

Pilosity fine, long, white, opaque to translucent; dorsal pronotum faintly rugulose in part; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum punctate anteriorly, grading to rugose-reticulate posteriorly; pronotal shoulders prominent, defined by transverse carina; anterior scutum smooth and shiny between moderately large scattered punctures, posterior scutum punctate-reticulate to rugose-reticulate, lateral scutum with scattered punctation; notauli well defined, crenulate; scutellum punctate with reticulation posteriorly, no lateral spines defined; dorsellum moderately prominent, not emarginate; mesopleuron longitudinally to obliquely striate to strigose; mesosternum smooth, with sparse faint punctation; propodeum $0.42\text{--}0.43 \times$ as long as wide, rugulose-reticulate to obliquely strigose, medial longitudinal furrow poorly defined, with sparse short pilosity laterally; postero-lateral area square to rounded; indentation about nucha shallow or absent; femora not swollen.

Wings

Hyaline to slightly infusate in apical half, with short fine setae; stigmal spot defined as translucent rounded patch, with translucent stigmal vein.

Metasoma

$1.74\text{--}1.89 \times$ as long as wide, with fine lateral pilosity; T1 $0.45\text{--}0.52 \times$ as long as upper anterior width, $0.29\text{--}0.39 \times$ as long as lower anterior width, longitudinally strigose with background reticulation; T2 rugulose-reticulate to finely longitudinally strigose; T3–T6 moderately finely reticulate; S1–S2 rugulose-reticulate; S3–S7 finely reticulate; S2 evenly convex basally in lateral view, without transverse ridge or furrow; S2–S3 without felt lines or nodes defined.

Distribution

Scelio chortoicetes is commonly collected in south-east New South Wales and the Australian Capital Territory; however, it has also been recorded from South Australia and Western Australia (Fig. 8.34).

Hosts

Austroicetes cruciata, *A. pusilla*, *A. vulgaris*, *Gastrimargus musicus*, collected on wing in area infested with *Phaulacridium vitatum* and *A. pusilla* (see Tables 4.2 and 4.3).

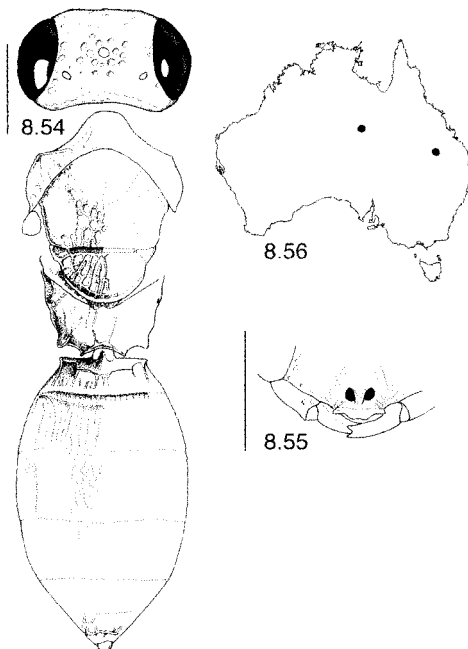
Comments

Scelio chortoicetes is the sister species of *S. pilosifrons* + *S. unidentis* (Fig. 6.2). The female of *S. chortoicetes* has only one apical mandibular tooth, as does *S. unidentis*. It can be separated from *S. pilosifrons* and *S. unidentis* by the fine pilosity, the concave or straight medial clypeal margin of the female (Fig. 8.32), the reduced sculpturing of the anterior scutum (Fig. 8.40), the dorsellum being weakly raised and not emarginate (Fig. 8.41), and the propodeum being weakly indented about the nucha (Figs 8.30, 8.31). Males of *S. chortoicetes* are variable with respect to the indentation either side of the nucha, which can be absent (Fig. 8.31) or present but very shallow and similar to that in females (Fig. 8.30). As for numerous other *Scelio* species, *S. chortoicetes* is distinctly sexually dimorphic, and varies in mandibular tooth number, sculpturing of the head, ocellar size, size of the temples (in dorsal view), mesosomal sculpturing, and the form of the basal area of S2. However, males and females are identical in the form of T1, sculpturing on T2–T3, indentation of the notauli, and form of the dorsellum.

SCELIO CONCINNUS DODD

(Figs 8.54–8.56)

Scelio concinnus Dodd, 1927: 145.- Galloway, 1976: 104; Galloway and Austin, 1984: 10; Johnson, 1992: 476.



Figs 8.54–8.56. *Scelio concinnus* Dodd:
 8.54. ♀ Holotype, dorsal habitus. 8.55. ♀
 Holotype, antero-ventral head.
 8.56. Distribution map. Scale lines:
 0.25 mm.

Material examined

Holotype

♀, Queensland, 'Morven Queensland A.P. Dodd', 26.25S, 147.07E (SAMA).

Other material examined

Northern Territory: 1 ♀, Plenty River, 245 km ENE Alice Springs, 23.00S, 136.08E, 14 Oct. 1978, J.C. Cardale (ANIC).

Female

Length

2.65–2.85 mm (mean 2.75 mm).

Colour

Orange except head dark brown, antennal funicle, scutellum, metanotum and metasoma light brown.

Head

Width between eyes $0.49\text{--}0.52 \times$ width of head in dorsal view; OOL $0.03\text{--}0.04$ mm; LOL $0.16\text{--}0.22$ mm; POL $0.28\text{--}0.3$ mm; ocellar diameter 0.05 mm, $0.11\text{--}0.12 \times$ width between eyes; head with very sparse, fine long pilosity, denser on temples; occiput strigose; posterior vertex smooth and shiny, with sparse transverse carinae and crenulae; medial vertex and dorsal frons with sparse moderately large punctures; ventral frons mostly smooth, with sparse punctation laterally; malar region virtually smooth, with very faint sparse radiating striae; malar space $0.42\text{--}0.48 \times$ as long as eye height; inter-antennal process short with raised lateral carinae; clypeus produced between lateral points, with medial margin straight to slightly concave; anteclypeus defined by broad, raised, smooth area; mandibles smooth, lower tooth $1.0\text{--}1.14 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity very sparse, long, translucent; dorsal pronotum virtually smooth; latero-dorsal pronotum faintly rugulose-reticulate; latero-ventral pronotum longitudinally striate; pronotal shoulders defined laterally only by oblique to transverse carina; anterior scutum virtually smooth, posterior scutum rugose-reticulate, lateral scutum smooth medially, with lateral crenulation; notauli well defined, crenulate; scutellum rugose-reticulate, with pattern appearing longitudinal medially, no lateral spines defined; dorsellum prominent, emarginate, with posterior points; mesopleuron longitudinally striate; mesosternum virtually smooth; propodeum $0.43\text{--}0.54 \times$ as long as wide, rugulose, medial longitudinal furrow present, defined by lateral carinae, with sparse short pilosity laterally, postero-lateral area pointed; indentation about nucha very broad and shallow.

Wings

Very lightly infuscate, with sparse, dark, fine, moderately long setae; oval tan-coloured translucent stigmal spot defined, without stigmal vein.

Metasoma

$1.69\text{--}1.71 \times$ as long as wide, with fine pilosity; T1 $0.4\text{--}0.6 \times$ as long as upper anterior width, $0.27\text{--}0.32 \times$ as long as lower anterior width, longitudinally striate; T2 longitudinally striate, becoming reticulate in apical two-thirds, smooth laterally; T3 rugulose-reticulate, smooth laterally; T4 faintly reticulate in basal quarter, smooth apically, T5 smooth; T6 smooth with apical furrow; S1 longitudinally striate in basal third, smooth apically; S2–S5 smooth, S2 without basal transverse ridge; S2–S3 without felt lines or nodes defined.

Male

Unknown.

Distribution

This species is known from central and central-eastern Australia (Fig. 8.56).

Host

Unknown.

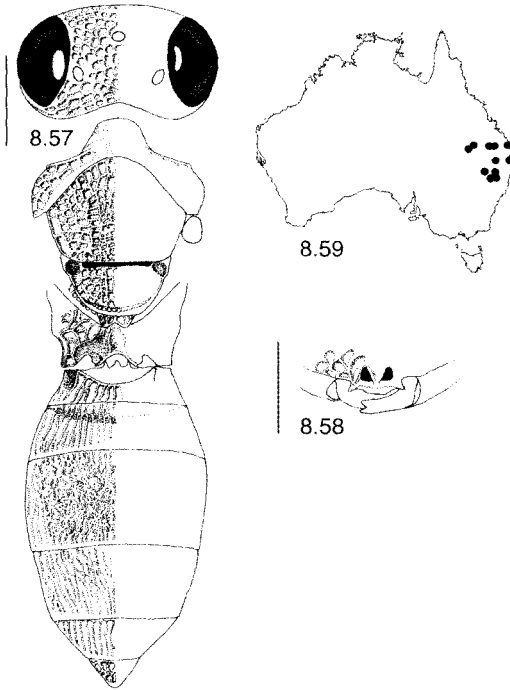
Comments

Scelio concinnus is resolved as the sister species of *S. anmarae*, although they are not united by any unequivocal characters (Fig. 6.2) (see comments under *S. anmarae*). Males of this species are inferred from the phylogenetic analysis as lacking antennal tyloids, as is the case for *S. mannesi*. *Scelio concinnus* is similar to *S. mannesi*, recorded only from males, and possibly they represent the opposite sexes of the same species. However, they differ in sculpturing, coloration, the form of the propodeum and T1, and for the present are best treated as separate taxa.

SCELIO CONTRACTUS DODD

(Figs 8.57–8.59)

Scelio contractus Dodd, 1927: 154.- Galloway, 1976: 104; Galloway & Austin 1984: 10; Johnson, 1992: 477.



Figs 8.57–8.59. *Scelio contractus* Dodd:
 8.57. ♀ Holotype, dorsal habitus.
 8.58. ♀ Holotype, antero-ventral head.
 8.59. Distribution map. Scale lines:
 0.25 mm.

Material examined*Holotype*

♀, Queensland, 'Chinchilla Qld. Jan, 26 T.A. Cole' (SAMA).

Paratypes

Queensland: 2 ♀, same data as holotype (SAMA, QMBA); 1 ♀, Goondiwindi, Dec. 1925, A.R. Taylor (ANIC); N.B. the ♂ paratype [Morven, Nov. 1925, A.P. Dodd] in ANIC is possibly not conspecific with the holotype (see comments below).

Other material examined

Queensland: 1 ♀, nr Broutha Scrub, Cooloola, 23 May 1981, G. Sarnes (QMBA); 3 ♀, Chinchilla, Nov. 1926 and 15 Jan. 1931, A.P. Dodd (ANIC); 1 ♀, 6 km W Chinchilla, 10–24 May 1987, G. Lithgow, M.T. (QMBA); 1 ♀, Cooloola, 9–20 Oct. 1978, E. Dahms (ASCU); 1 ♀, Charleville, bank of Warrego River, dry grass, 9 Oct. 1974, I.D. Galloway (ASCU); 2 ♀, Dulacca, Nov. 1925, A.P. Dodd (ANIC); 2 ♀, Goondiwindi, Oct. and Jan. 1928, A.P. Dodd (ANIC); 1 ♀, Goondiwindi, Dec. 1925, A.R. Taylor (ANIC); 1 ♀, Morven, A.P. Dodd (ANIC). **New South Wales:** 1 ♀, Barraba, Long Arm, 28 Nov. 1993, sweeping near *Praxibus* sp., R. Pigott (ASCU); 1 ♀, Brunswick Heads, 4 May 1931, A.P. Dodd (ANIC); 2 ♀, Gravesend, Apr. 1928, H.T. Nicholas (ANIC); 1 ♀, Moonie River, Oct. 1926, A.P. Dodd (ANIC); 1 ♀, Pilliga Scrub, 64 km S of Narrabri, 4 Dec. 1976, on *Leptospermum*, E.M. Exley (ANIC); 1 ♀, Royal Nat. Pk, 20 km S of Sydney, 5–14 Jun. 1978, S. & P. Peck, gorge rain forest (CNCI).

Female

Length

3.0–3.8 mm (3.35 mm).

Colour

Dark to medium brown except legs, basal antennae, mandibles and palps yellow.

Head

Width between eyes $0.42\text{--}0.49 \times$ width of head in dorsal view; OOL $0.02\text{--}0.04$ mm; LOL $0.2\text{--}0.24$ mm; POL $0.28\text{--}0.36$ mm; ocellar diameter $0.06\text{--}0.07$ mm, $0.14\text{--}0.17 \times$ width between eyes; head with coarse stout translucent pilosity; occiput rugulose; posterior vertex rugose-reticulate; medial vertex punctate-reticulate; frons and malar region with moderately coarse reticulate punctation; malar space $0.4\text{--}0.55 \times$ as long as eye height; interantennal process broad dorsally, with lateral carinae continuing around antennal sockets, not onto frons; clypeus very slightly produced between lateral points, with medial margin straight to convex; anteclypeus defined by raised, smooth marginal area; mandibles smooth, lower tooth $0.8\text{--}0.9 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity coarse, stout and translucent on lateral pronotum, becoming finer on dorsal pronotum and medial scutum; dorsal pronotum transversely strigose; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum longitudinally strigose; pronotal shoulders prominent, only in outer half defined by transverse carina; scutum rugose-reticulate to punctate-reticulate becoming less well defined laterally; notauli moderately well defined, crenulate; scutellum rugose-reticulate, no lateral spines defined; dorsellum prominent, emarginate, produced into latero-posterior points; mesopleuron longitudinally striate; mesosternum rugulose-reticulate laterally, becoming smoother medially; propodeum $0.33\text{--}0.44 \times$ as long as wide, rugulose-reticulate, medial longitudinal furrow present, postero-lateral area square; indentation about nucha present.

Wings

Lightly infuscate, with moderately coarse, dark short setae; stigmal spot defined as elongated translucent area, with short translucent stigmal vein.

Metasoma

1.7–1.85 × as long as wide, with fine lateral pilosity; T1 0.3–0.42 × as long as upper anterior width, 0.2–0.28 × as long as lower anterior width, longitudinally strigose; T2 longitudinally striate to strigose; T3 moderately finely reticulate; T4–T6 longitudinally strigose; S1–S2 longitudinally strigose; S3–S5 smooth medially, strigose laterally; S2 with basal transverse furrow; S2–S3 without felt lines or nodes defined.

Male

Unknown.

Distribution

Scelio contractus has been collected from southern Queensland and northern New South Wales (Fig. 8.59).

Host

The host of this species is unknown, but specimens have been swept near *Praxibulus* sp.

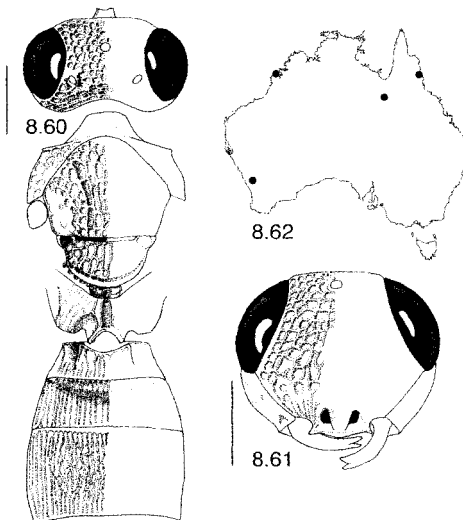
Comments

Scelio contractus is the sister species to *S. pigotti* (Fig. 6.2) and is differentiated by the colour of the coxae, the depth of the emargination of the dorsellum, and the transverse sculpturing of the posterior vertex. Dodd (1927) stated that *S. contractus* is close to *S. nigricornis*, which is only known from males. The phylogenetic analysis infers that males of *S. contractus* should lack tyloids; however, tyloids are present in *S. nigricornis*. The one male paratype from Morven, Queensland designated by Dodd (1927) (in ANIC) cannot be positively associated with the female sex of this species. For this reason and to guard against potential confusion in the future, it should be treated as possibly not conspecific with the holotype.

SCELIO CRUENTATUS DODD

(Figs 8.60–8.62)

Scelio cruentatus Dodd, 1914b: 112.–Kieffer, 1926: 337; Dodd, 1927: 146; Galloway, 1976: 104; Galloway & Austin 1984: 10; Johnson, 1992: 477.



Figs 8.60–8.62. *Scelio cruentatus* Dodd: 8.60. ♀ Holotype, dorsal head to T3. 8.61. ♀ Holotype, anterior head. 8.62. Distribution map. Scale lines: 0.25 mm.

Material examined

Holotype

♀, Queensland, no data label on type but 'Cloncurry, April, A.P. Dodd' quoted in original description (SAMA).

Other material examined

Queensland: 1 ♀, 126 km up Tinaroo Crk Rd via Mareeba, 12–28 Jan. 1983, Storey and Brown, F.I.T. (ASCU). **Western Australia:** 1 ♀, 6 km W of Martin's Well, West Kimberley, 16.35S, 122.48E, 26 Apr. 1977, D.H. Colless (ANIC); 1 ♀, 3–12 mls N Moora, 5 Jan. 1966, J. A. Grant (ANIC).

Female

Length

3.2–4.1 mm (mean 3.55 mm).

Colour

Orange except head, excluding mandibles and palps, black.

Head

Width between eyes $0.46\text{--}0.48 \times$ width of head in dorsal view; OOL $0.02\text{--}0.03$ mm; LOL $0.19\text{--}0.22$ mm; POL $0.3\text{--}0.34$ mm; ocellar diameter $0.05\text{--}0.08$ mm, $0.13\text{--}0.16 \times$ width between eyes; head with fine, sparse translucent pilosity; occiput weakly rugulose; posterior vertex rugose-reticulate, with distinct transverse trend; medial vertex punctate-reticulate; frons irregularly punctate-reticulate; malar region with short radiating striae ventrally, becoming smooth to weakly punctate-reticulate dorsally; malar space $0.49\text{--}0.53 \times$ as long as eye height; interantennal process broad, with lateral carinae continuing around antennal sockets, not onto frons; clypeus very weakly produced between lateral points, medial margin evenly convex; anteclypeus defined by raised, smooth marginal area; mandibles smooth, lower tooth subequal to upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, sparse, short, translucent; dorsal pronotum smooth; latero-dorsal pronotum weakly punctate-reticulate; latero-ventral pronotum longitudinally strigose; pronotal shoulders prominent, defined by transverse carina; scutum rugose-reticulate; notauli poorly defined amongst sculpturing of scutum; scutellum rugose-reticulate, no lateral spines defined; dorsellum moderately prominent, only very slightly emarginate, with rounded lateral lobes; mesopleuron longitudinally striate; mesosternum smooth; propodeum $0.44\text{--}0.48 \times$ as long as wide, obliquely strigose laterally, medial longitudinal furrow present, postero-lateral area rounded; indentation about nucha present.

Wings

Lightly infusate in apical two-thirds, with fine short setae; stigmal spot defined as elongated translucent area with short translucent stigmal vein, infusate only at apex.

Metasoma

$2.3\text{--}2.6 \times$ as long as wide, with sparse fine pilosity; T1 $0.33\text{--}0.44 \times$ as long as upper anterior width, $0.27\text{--}0.3 \times$ as long as lower anterior width, longitudinally strigose; T2 longitudinally striate; T3 longitudinally strigose with reticulation medially; T4–T5 longitudinally striate; T6 rugose-reticulate; S1–S5 longitudinally strigose, S2 with shallow basal transverse ridge; S2–S3 without felt lines or nodes defined.

Male

Unknown.

Distribution

This species is known from widely separated regions: from north and central Queensland and north-western and south-western Western Australia (Fig. 8.62).

Host

Unknown.

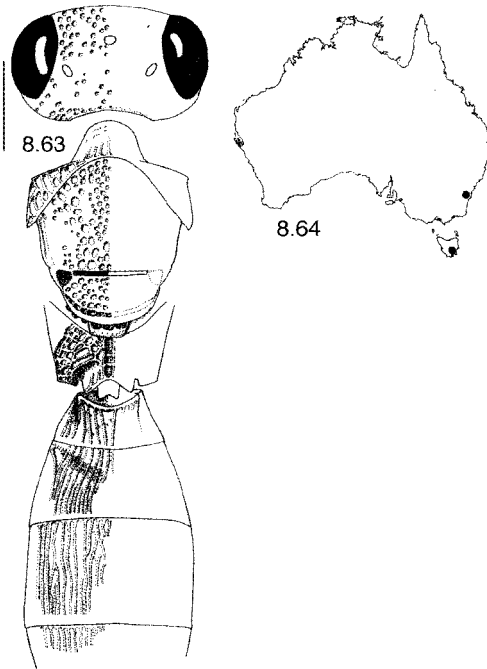
Comments

Scelio cruentatus is the sister species of the clade defined by having the mesosternum sculptured (Fig. 6.2, node 4). Males for this species are inferred from the phylogenetic analysis as lacking antennal tyloids. As indicated by Dodd (1927), this species is similar to *S. nigricornis*, but males of the latter species have tyloids. Also, *S. cruentatus* can be recognised by the absence of white pubescence on the head and mesosoma.

SCELIO DIEMENENSIS DODD

(Figs 8.63, 8.64)

Scelio diemenensis Dodd, 1914b: 112.- Kieffer, 1926: 338; Dodd, 1927: 173; Galloway, 1976: 104; Galloway & Austin 1984: 10; Johnson, 1992: 477.



Figs 8.63, 8.64. *Scelio diemenensis* Dodd: 8.63. ♀ Holotype, dorsal head to T4. 8.64. Distribution map. Scale line: 0.25 mm.

Material examined*Holotype*

♀, 'Hobart Tas. (Lea)' (ASCU).

Paratype

Tasmania: ♀, same data as holotype (ANIC).

Other material examined

New South Wales: 6 ♀, Braidwood, 22 Dec. 1980 & 28 Jan. 1981, R.A. Farrow (ASCU).

Female

Length

3.5–3.7 mm.

Colour

Brown except legs and mandibles yellow; coxae light to medium brown.

Head

Width between eyes $0.54\text{--}0.55 \times$ width of head in dorsal view; OOL 0.05 mm; LOL 0.19–0.2 mm; POL 0.32–0.35 mm; ocellar diameter 0.06–0.08 mm, $0.13\text{--}0.15 \times$ width between eyes; head with fine, short, sparse pilosity; occiput smooth; posterior vertex smooth to sparsely punctate, with transverse trend; medial vertex smooth, with sparse, fine, scattered punctures; frons punctate; malar region with radiating striae, continuing onto ventral frons; malar space $0.42\text{--}0.5 \times$ as long as eye height; interantennal process smooth with lateral carinae, continuing around antennal sockets, not onto frons; clypeus produced between lateral points, medial margin straight to convex; anteclypeus weakly defined by raised smooth marginal area; mandibles smooth, lower tooth subequal in length to upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, sparse, moderately long; dorsal pronotum smooth; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum irregularly punctate; pronotal shoulders prominent, defined by oblique-transverse carina; anterior and posterior scutum moderately punctate, lateral scutum mostly smooth with fine punctation; notauli very weakly defined by slightly coarser punctation and gentle depression; scutellum punctate, no lateral spines defined; dorsellum not prominent, only slightly raised above lateral metanotum, not emarginate; mesopleuron punctate; mesosternum punctate-reticulate; propodeum $0.52 \times$ as long as wide, rugose-reticulate laterally, narrow, deep medial longitudinal furrow present, postero-lateral area oblique to square; indentation about nucha narrow but moderately deep.

Wings

Lightly infusate, with short fine setae; stigmal spot defined as moderately large opaque to translucent area, with long, lightly infusate to spectral stigmal vein.

Metasoma

$2.27\text{--}2.42 \times$ as long as wide, with fine sparse pilosity; T1 $0.7\text{--}0.75 \times$ as long as upper anterior width, $0.7\text{--}0.75 \times$ as long as lower anterior width, longitudinally striate; T2 longitudinally striate, becoming slightly fainter medially; T3 longitudinally striate-reticulate; T4–T5 longitudinally striate, with smooth medial patch; T6 smooth; S1–S3 longitudinally striate; S4 striate laterally, smooth medially; S5 smooth, S2 with low basal transverse ridge; S2–S3 without felt lines or nodes defined.

Male

Unknown.

Distribution

This species is known from two south-eastern localities: Tasmania and south-eastern New South Wales (Fig. 8.64).

Host

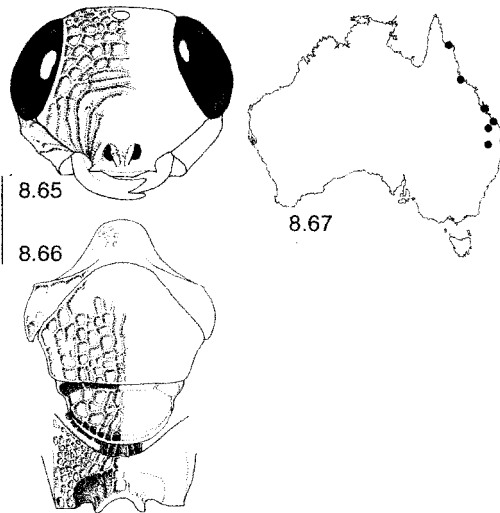
Unknown.

Comments

Scelio diemenensis is similar to *S. striatifacies* but can be distinguished by having poorly defined notauli. Three female specimens, not listed above, collected at Lake Broadwater, New South Wales (in ASCU) are intermediate between *S. diemenensis* and *S. striatifacies* in the form of the notauli, and sculpturing of the scutum and posterior vertex. These specimens may represent the extreme in variation for these characters, for one species or the other, or they may indicate that a single highly variable species exists. At present, there is insufficient material to assess which of these hypotheses is more likely. Males for this species are inferred from the phylogenetic analysis as lacking antennal tyloids.

SCELIO DODDI DANGERFIELD & AUSTIN SP. NOV.

(Figs 8.65–8.67)



Figs 8.65–8.67. *Scelio doddi* sp. nov.:
8.65. ♀ Holotype, anterior head.
8.66. ♀ Holotype, dorsal mesosoma.
8.67. Distribution map. Scale line:
0.25 mm.

Material examined

Holotype

♀, Queensland, 'Goondiwindi 9 Jany, 1929 A.P Dodd' (ANIC).

Paratypes

Queensland: 1♀, Koy Property at Brigooda, 26.16S, 151.25E, 15 Dec. 1994–26 Jan. 1995, G.B. Monteith (QMBA); 3♀, Chinchilla, 9 Feb. 1928, A.P. Dodd (ANIC); 1♀, Chinchilla, 15 Jan. 1927, A.P. Dodd (ANIC); 1♀, Chinchilla, 9 Feb. 1932, A.P. Dodd (ANIC); 2♀, Gogango, 9 Oct. 1932, A.P. Dodd (ANIC); 1♀, 3 km NE Mt Webb, 15.03S, 145.09E, 30 Apr.–3 May 1981, I.D. Naumann, MT (ANIC); 1♀, Townsville, James Cook Uni campus, 21–26 May 1988, A.D. Austin (WINC).

Female

Length

3.2–3.4 mm (mean 3.4 mm).

Colour

Head, scutellum and dorsellum dark brown to black; metasoma and mandibles light brown; remainder of mesosoma and legs yellow to orange.

Head

Width between eyes $0.39\text{--}0.46 \times$ width of head in dorsal view; OOL 0.04 mm; LOL 0.21 mm; POL 0.33 mm; ocellar diameter $0.07\text{--}0.09$ mm, $0.15\text{--}0.2 \times$ width between eyes; head with moderately coarse pilosity; occiput strigose; posterior vertex rugose-reticulate; medial vertex punctate-reticulate; dorsal frons punctate-reticulate to rugose-reticulate; malar region with radiating striae arching and meeting above speculum then becoming reticulate to punctate-reticulate; malar space $0.45\text{--}0.5 \times$ as long as eye height; interantennal process short, broad and crenulate with lateral carinae; clypeus moderately produced between lateral points, sometimes slightly concave medially, otherwise straight; anteclypeus defined by narrow, raised, smooth area; mandibles smooth, lower tooth $0.8\text{--}1.0 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity mostly fine, slightly coarser on lateral pronotum; dorsal pronotum rugulose; latero-dorsal pronotum smooth anteriorly to faintly rugulose-reticulate posteriorly; latero-ventral pronotum smooth anteriorly to strigose posteriorly; pronotal shoulders prominent, defined by transverse carina; anterior scutum virtually smooth, posterior and lateral scutum rugose-reticulate to punctate-reticulate; notauli poorly defined amongst sculpturing; scutellum rugose-reticulate, no lateral spines defined; dorsellum prominent, slightly emarginate, forming two dorso-posterior points; mesopleuron striate-reticulate; mesosternum punctate to punctate-reticulate laterally; propodeum $0.35\text{--}0.45 \times$ as long as wide, rugulose-reticulate about poorly defined medial longitudinal furrow, sparse fine lateral pilosity, postero-lateral area square; indentation about nucha shallow and moderately broad.

Wings

Lightly infusate, with short fine setae; stigmal spot translucent infusate with faintly infusate apical vein.

Metasoma

$1.9 \times$ as long as wide, with fine, sparse pilosity laterally; T1 $0.3\text{--}0.35 \times$ as long as upper anterior width, $0.2\text{--}0.23 \times$ as long as lower anterior width, longitudinally strigose-reticulate; T2 longitudinally striate; T3 rugose-reticulate medially, becoming strigose laterally; T4–T5 strigose; T6 strigose with foveolae; S1–5 punctate-reticulate to punctate; S2 with shallow basal transverse ridge, felt fields defined.

Male

Unknown.

Distribution

Scelio doddi is known from northern coastal to southern Queensland (Fig. 8.67).

Host

Unknown.

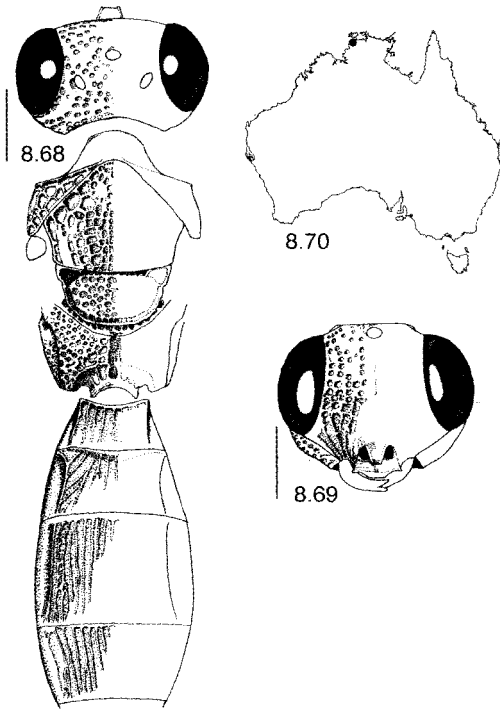
Comments

Scelio doddi is the sister species to *S. flavigaster* plus clade 5, the latter group defined by having a punctate mesopleuron (Fig. 6.2). Males for this species are inferred from the phylogenetic analysis as lacking antennal tyloids. This species is named in honour of Alan Parker Dodd for his pioneering work on the taxonomy of Australian scelionid wasps.

SCELIO ERYTHROPUS DODD

(Figs 8.68–8.70)

Scelio erythropus Dodd, 1920: 345.- Dodd, 1927: 146; Masner, 1965: 93; Galloway, 1976: 105; Galloway & Austin 1984: 10; Johnson, 1992: 478.



Figs 8.68–8.70. *Scelio erythropus* Dodd.:
 8.68. ♀ Holotype, dorsal head to T4.
 8.69. ♀ Holotype, anterior head.
 8.70. Distribution map. Scale lines:
 0.25 mm.

Material examined

Holotype

♀, Northern Territory, 'Adelaide River 92-4' (BMNH).

Female

Length

4.2 mm.

Colour

Orange to yellow except head, antennal segments 3–6, apical half of T3, T4–T7, apical half of S3, and S4–S6 black, scutellum and tegula light brown.

Head

Width between eyes $0.49 \times$ width of head in dorsal view; OOL 0.05 mm; LOL 0.17 mm; POL 0.38 mm; ocellar diameter 0.08 mm, $0.15 \times$ width between eyes; head with fine, short pilosity associated with punctation; occiput virtually smooth, occipital carina well defined; posterior vertex coarsely punctate with foveolae; medial vertex with sparse moderately coarse punctation; dorsal frons foveolate to reticulate-rugose; malar region with coarse radiating carinae reaching halfway up frons; malar space $0.43 \times$ as long as eye height; interantennal process rugulose with slight lateral carinae; clypeus slightly produced between lateral points, medial clypeal margin straight; anteclypeus defined by raised smooth region along margin; mandibles smooth, lower tooth $0.63 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Dorsal pronotum virtually smooth; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum smooth anteriorly to punctate posteriorly; pronotal shoulders prominent; anterior scutum punctate, posterior scutum punctate-reticulate, lateral scutum punctate; notauli crenulate, poorly defined; scutellum punctate laterally, becoming reticulate-rugose medially, no lateral spines defined; dorsellum only very slightly prominent, not emarginate; mesopleuron moderately finely punctate; propodeum $0.40 \times$ as long as wide, punctate laterally to rugulose reticulate medially about poorly defined medial longitudinal furrow, with sparse, short pilosity laterally, postero-lateral area obliquely square to rounded; indentation about nucha present.

Wings

Lightly infusate, with long, coarse setae; stigmal spot poorly defined as buff coloured translucent-opaque area, with stigmal vein spectral and poorly defined.

Metasoma

$2.6 \times$ as long as wide; T1 $0.7 \times$ as long as upper anterior width, $0.68 \times$ as long as lower anterior width, with coarse well-defined longitudinal striae; T2 longitudinally striate, becoming weaker to smooth medio-apically and oblique laterally; T3–T5 longitudinally striate, with medio-apical smooth patch; T6 with coarse punctures; S1–S5 virtually smooth; S2 with basal transverse crenulate ridge, broad low felt nodes defined.

Male

Unknown.

Distribution

Scelio erythropus is known only from the holotype collected at Adelaide River, Northern Territory (Fig. 8.70).

Host

Unknown.

Comments

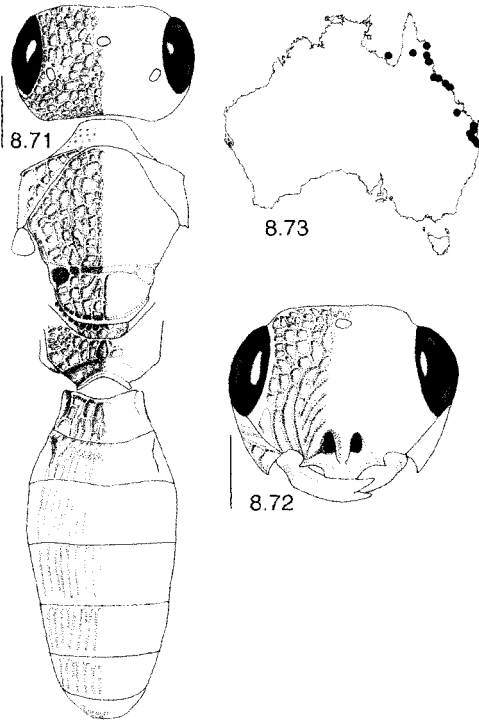
Previously this species has been distinguished only by the pale yellow colour of the apical antenna (Dodd 1927). However, a number of other characters have been recognised here that diagnose *S. erythropus*. These include the scutum being punctate-reticulate, coxae yellow, T2–T4 longitudinally strigose with a smooth medial patch, S2–S5 virtually smooth, and S2 with broad, low felt nodes defined. It is the sister species of *S. petilus* from which it can be distinguished by the orange scutum and coxae, the complete occipital carina, and the sculpturing of the malar region. It is part of the clade including *S. diemenensis* + *S. punctaticeps*

+ *S. fulgidus* + *S. petilus*, which is defined by having a low dorsellum (Fig. 6.2). Males for this species are inferred from the phylogenetic analysis as having antennal tyloids present.

SCELIO FLAVICORNIS DODD

(Figs 8.71–8.73)

Scelio flavicornis Dodd, 1913a: 136.- Kieffer, 1926: 341; Dodd, 1927: 162; Galloway, 1976: 105; Galloway & Austin 1984: 10; Johnson, 1992: 479.



Figs 8.71–8.73. *Scelio flavicornis* Dodd.:
8.71. ♂ Holotype, dorsal habitus. 8.72. ♂
Holotype, anterior head. 8.73. Distribution
map. Scale lines: 0.25 mm.

Material examined

Holotype

♂, Queensland, 'sweeping in forest, Nelson n.Q. 20.II.23 A.P.Dodd' (label on slide) (SAMA).

Other material examined

Queensland: 1♂, Carr Ck, 18 km NNW Mareeba, 21 May 1980, I.D. Naumann, J.C. Cardale (ANIC); 3♂, Deadman Ck, 9 km S Proserpine, 10 May 1980, J.C. Cardale, I.D. Naumann (ANIC); 2♂, Emmett Ck, 10 km NW Giru, 11 May 1980, I.D. Naumann, J.C. Cardale (ANIC); 1♂, Gatton, DPI Research Station, 16–24 Mar. 1981 (QDPC); 1♂, Gogango, Dec. 1929, A.P. Dodd (ANIC); 1♂, Landsborough, 22 Feb. 1978, J.F. Donaldson (QDPC); 1♂, 45 km W Lynd River, 24 Apr. 1983, wild rice (QDPC); 2♂, 4 km W Mareeba, 23 May 1980, I.D. Naumann, J.C. Cardale (ANIC); 1♂, Mornington Island, 18 Apr. 1983, J.F. Donaldson (QDPC); 2♂, 3.5 km SbySW Mount Baird, 15.10S, 145.07E, 3–5 May 1981, I.D. Naumann (ANIC); 1♂, Mt Tamborine, 23 Feb. 1972, I.D. Galloway (QDPC); 1♂, Moura, Brigalow development area, 19 Jan. 1966, ex Rhodes grass,

P.D. Rossiter (ASCU); 2♂, Ormiston, 28 Dec. 1966, J.H. Barrett (ASCU); 1♂, 3 km E Palmwoods, 22 Feb. 1978, J.F. Donaldson (QDPC); 1♂, Proserpine, 7 Jul. 1982, H. Anderson (CNCI); 1♂, Rosevale Area, 16 Mar. 1975, B.K. Cantrell (QDPC); 1♂, Townsville, 5 Feb. 1945, B. Malkin (USNM).

Male

Length

3.8–4.2 mm (mean 3.9 mm).

Colour

Dark brown except coxae light to mid brown, distinctly darker than yellow trochanter to tarsus.

Head

Width between eyes $0.57\text{--}0.6 \times$ width of head in dorsal view; OOL $0.04\text{--}0.05$ mm; LOL $0.28\text{--}0.31$ mm; POL $0.49\text{--}0.50$ mm; ocellar diameter $0.08\text{--}0.09$ mm, $0.13\text{--}0.15 \times$ width between eyes; head with coarse feather-like, long white pilosity, becoming finer and tan colour towards medial vertex; occiput moderately finely rugulose-reticulate; posterior vertex to dorsal frons rugose-reticulate; ventral frons longitudinally strigose; malar region with radiating striae, becoming strigose dorsally; malar space $0.5\text{--}0.54 \times$ as long as eye height; interantennal process narrow especially ventrally, with lateral carinae continuing around antennal sockets, not onto frons; clypeus well produced between lateral points, with medial margin straight and spade-like; anteclypeus not clearly defined; mandibles either smooth or with medial reticulation, lower tooth $0.73\text{--}0.87 \times$ upper tooth, small dorsal tooth present; antennal segment 5 not enlarged, without tyloid, clava covered with small basiconic sensilla.

Mesosoma

Pilosity fine on dorsal pronotum, otherwise coarse, long, feather-like, white, becoming tan coloured on medial scutum and scutellum; dorsal pronotum with fine punctation; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum smooth anteriorly becoming rugose-reticulate posteriorly; pronotal shoulders prominent, defined by transverse carina; scutum rugose-reticulate; notauli not defined amongst sculpturing of scutum; scutellum rugose-reticulate, no lateral spines defined; dorsellum moderately prominent, not emarginate; mesopleuron rugulose-reticulate with oblique transverse trend; mesosternum punctate-reticulate; propodeum $0.44\text{--}0.47 \times$ as long as wide, rugose-reticulate, short medial longitudinal furrow present, with coarse, white lateral pilosity, postero-lateral area rounded; indentation about nucha absent.

Wings

Lightly infusate, with short, fine, light brown setae; stigmal spot defined as light brown area, with short stigmal vein.

Metasoma

$2.11\text{--}2.26 \times$ as long as wide, with coarse long feather-like pilosity laterally; T1 $0.60\text{--}0.70 \times$ as long as upper anterior width, $0.56\text{--}0.61 \times$ as long as lower anterior width, rugose-reticulate; T2 very faintly longitudinally striate; T3–T6 faintly striate, smooth medially; T7 apically punctate; S1 rugose-reticulate; S2–S5 strigose laterally, smooth medially; S2 with basal transverse ridge; S2–S3 with raised finely striate felt nodes defined.

Female

Unknown.

Distribution

This species is widespread throughout coastal Queensland (Fig. 8.73).

Host

Chortoicetes terminifera (Baker *et al.* 1996) but not confirmed by examination of material.

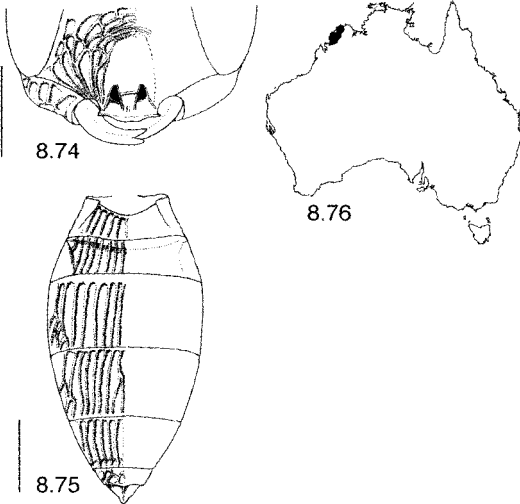
Comments

Scelio locustae and *S. perplexus* are here removed from synonymy with *S. flavicornis* (see comments under *S. locustae*). *Scelio pilosus* and *S. pilosiceps* are also removed from synonymy with this species, these two only being known from females while *S. flavicornis* is known only from males. Given the level of sexual dimorphism evident among most *Scelio* species, there is no evidence to support the previous synonymy of any of the above species under *S. flavicornis* (Dodd 1927). It is just as likely that the opposite sex of *S. flavicornis* and *S. pilosus* are to be found elsewhere among described or undescribed species currently known only from one sex. Therefore, these species have been reinstated to guard against what may otherwise lead to taxonomic confusion in the future. *Scelio flavicornis* was not included in the phylogenetic analysis as it is only known from males.

Scelio flavicornis can be distinguished from males of *S. locustae* by the medially smooth T2–T4 and the buff to light-coloured apical part of the tubular stigmal vein. This species is also very similar to *S. setafascis*, but it can be distinguished by the brown colour of the coxae, the wings lacking longer and coarser apical microtrichia, and the apical part of the stigmal vein being defined. Some specimens (ANIC), provisionally assigned to this species, differ in having the medial part of the mandible with reticulate sculpturing of varied intensity.

SCELIO FLAVIGASTER DANGERFIELD & AUSTIN SP. NOV.

(Figs 8.74–8.76)



Figs 8.74–8.76. *Scelio flavigaster* sp. nov.:

8.74. ♀ Holotype, lower anterior head.

8.75. ♀ Holotype, dorsal metasoma.

8.76. Distribution map. Scale lines:
0.25 mm.

Material examined

Holotype

♀, Western Australia, '15.38S 125.15E CALM Site 28/3 4 km W of King Cascade W.A. 12–16 June 1988, T.A. Weir' 'Malaise trap with trough closed forest' (ANIC).

Paratypes

Western Australia: 7♀, same data as holotype; 1♀, 'Marun' CALM Site 8/4, Prince Frederick Harbour, 15.00S, 125.21E, 6–11 June 1988, I.D. Naumann (ANIC); 2♀, Charnley River 16.22S, 125.12E, 2 km SW Rolly Hill, CALM Site 25/2, 16–20 June 1988, I.D. Naumann (ANIC); 1♀, 12 km S of Kalumburu Mission, CALM Site 13/4, 14.25S, 126.38E, 7–11 June 1988 (ANIC).

Female

Length

3.55–3.6 mm (mean 3.6 mm).

Colour

Brown except toruli, mandibles, palps, propodeum, hind legs and metasoma yellow to orange.

Head

Width between eyes $0.47\text{--}0.49 \times$ width of head in dorsal view; OOL $0.04\text{--}0.05$ mm; LOL 0.2 mm; POL 0.29 mm; ocellar diameter 0.09 mm, $0.18 \times$ width between eyes; head with fine, translucent, moderately long pilosity; occiput punctate medially to punctate-reticulate dorso-laterally; vertex and dorsal frons deeply punctate-reticulate; malar region with radiating striae, meeting and becoming reticulate above speculum; malar space $0.44\text{--}0.45 \times$ as long as eye height; interantennal process short, broad, and crenulate, with well-developed lateral carinae; clypeus moderately produced and convex between lateral points; anteclypeus defined by raised smooth area; mandibles smooth, lower tooth $0.83\text{--}1.0 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, long, translucent; dorsal pronotum rugulose; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum rugose-reticulate; pronotal shoulders prominent, defined by transverse carina; scutum punctate-reticulate to rugose-reticulate; notauli not defined amongst sculpturing; scutellum rugose-reticulate, no lateral spines defined; dorsellum prominent, very slightly emarginate; mesopleuron punctate medially to punctate-reticulate laterally; mesosternum smooth with scattered punctures; propodeum $0.46\text{--}0.47 \times$ as long as wide, rugose-reticulate about shallow, partly crenulate medial longitudinal furrow, with fine, short, sparse pilosity laterally, with postero-lateral area square; propodeum indented about nucha.

Wings

Lightly infusate in basal half, with moderately dark infuscation apically, with short fine setae; dark infusate translucent stigmal spot defined, with faint stigmal vein.

Metasoma

$1.81\text{--}1.97 \times$ as long as wide in dorsal view; fine long sparse pilosity; T1 $0.38\text{--}0.41 \times$ as long as upper anterior width, $0.31\text{--}0.33 \times$ as long as lower anterior width, longitudinally striate; T2 and T4 striate; T3 and T5 strigose; T6 punctate-reticulate; S1–5 strigose-reticulate with foveolae; S2 with shallow basal transverse ridge, felt nodes defined.

Male

Unknown.

Distribution

Scelio flavigaster is known from northern-western Western Australia (Fig. 8.76).

Host

Unknown.

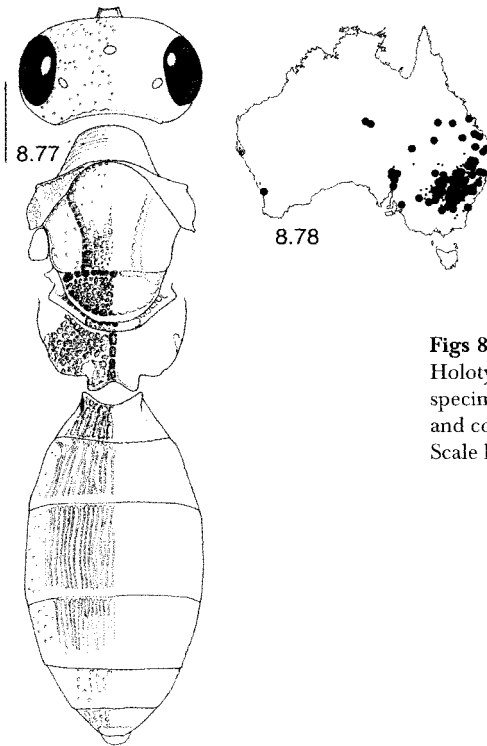
Comments

Scelio flavigaster is basal within the clade defined by having the mesopleuron punctate (Fig. 6.2, node 5). This species is named after the yellow colour of the metasoma, propodeum and hind legs, which contrasts with the dark brown colour of the rest of the body (see under *S. doddi* for comments on relationships).

SCELIO FULGIDUS CRAWFORD

(Figs 8.77–8.84)

Scelio fulgidus Crawford, 1911: 269.- Dodd, 1913a: 138; Dodd, 1914b: 118; Kieffer, 1926: 338; Dodd, 1927: 142; Masner and Muesebeck, 1968: 44; Galloway, 1976: 105; Galloway & Austin 1984: 10; Johnson, 1992: 480.

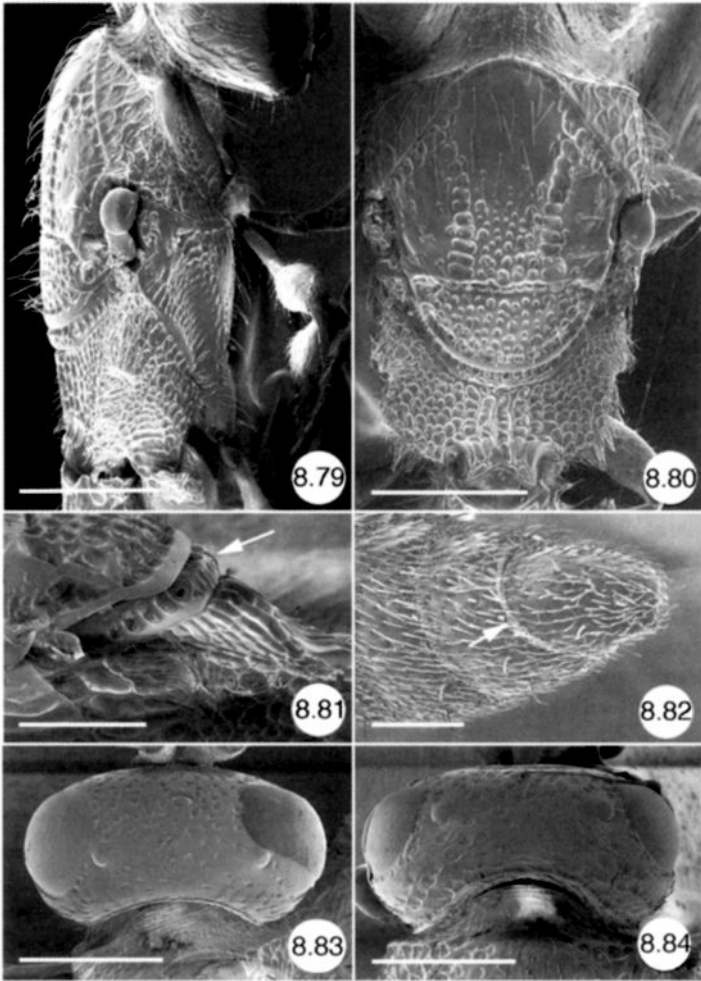


Figs 8.77, 8.78. *Scelio fulgidus* Crawford: 8.77. ♀ Holotype, dorsal habitus. 8.78. Distribution map of specimens examined during this study (large dots) and collection sites of Baker *et al.* (1996) (small dots). Scale line: 0.25 mm.

Material examined

Holotype

♀, New South Wales, 'Parasite on Locust eggs *Pachytylus australis*' 'New South Wales' (USNM).



Figs 8.79–8.84. *Scelio fulgidus* Crawford: **8.79.** ♀, lateral mesosoma. **8.80.** ♀, dorsal mesosoma. **8.81.** ♀, lateral metanotum, with slightly raised dorsellum arrowed. **8.82.** ♀, antennal apex, with fine setae at apex of segment arrowed. **8.83.** ♀, dorsal head. **8.84.** ♂, dorsal head. Scale lines: 8.79, 8.80, 8.83, 8.84, 0.4 mm; 8.81, 0.2 mm; 8.82, 40 µm.

Other material examined

Queensland: 1 ♂, Canaway Downs near Adavale, 6 Jun. 1970, D. Clark (ANIC); 1 ♀, 41 km N Charleville, Warrego River, 16 May 1991, E.C. Dahms, G. Sarnes (QMBA); 1 ♀, Dalby-Jimbour, 12 Oct. 1976, F. Sinclair (ASCU); 4 ♀, 3 ♂, Darling Downs, 22 Dec. 1921, W. Leslie, bred from eggs of *C. terminifera* (ANIC); 2 ♀, Darling Downs, 27 Dec. 1921, M.W. Leslie, ex eggs *C. terminifera* (ASCU); 14 ♀, Esk, 24 Apr. 1937, J.A. Weddell, from egg beds of *C. terminifera* (ASCU); 1 ♀, Gayndah, Oct. 1927, A.P. Dodd (ANIC); 2 ♀, 4 ♂, 30 km S Longreach, 20 Jan. 1972, R Davies (ANIC); 4 ♀, 1 ♀, Marlborough, Belah Valley, 13 Dec. 1971, R. Elder, ex *C. terminifera* eggs (ASCU); 1 ♀, Mt Abbott, rainforested gully, SE slopes,

20.06S, 147.45E, 10 Apr. 1997, C.J. Burwell (QMBA); 1 ♀, Roma, Mar. 1925, A.P. Dodd (ANIC); 38 ♀, 8 ♂, Toogoolawah, 29 Apr. 1937, J.A. Weddell, ex eggs *C. terminifera* (ASCU). **New South Wales:** 1 ♀, 1 ♂, 1930, 1931, grass-hopper eggs, no date or collector (ASCU); 3 ♀, 3 ♂, parasite on locust eggs of *Pachytylus australis*, no date or collector (ASCU); 2 ♀, Albert, Oct. 1979, G. Baker (ASCU); 1 ♀, Arianah Park, 21 Dec. 1992, R. Pigott (ASCU); 1 ♀, 1 ♂, Balranald, 20 Oct. 1984, R. Pigott (ASCU); 5 ♀, Barrington Tops, 5 Feb. 1931, A.P. Dodd (ANIC); 7 ♂, Bedgerabong, 19 Nov. 1992, R.G. Pigott (ASCU); 2 ♀, Belarabon, 15 Oct. 1970, C.A. Gauchat (ASCU); 4 ♀, 1 ♂, Booligal, 19 Oct. 1984, R. Pigott (ASCU); 1 ♀, 1 ♂, Bourke, 7 Mar. 1985, R. Pigott (ASCU); 2 ♂, Braidwood, 17 Feb. 1982 (ASCU); 4 ♂, Bundarra, 1 Feb. 1993, R. Pigott (ASCU); 1 ♀, Cassilis, 18 Feb. 1993, R. Pigott (ASCU); 2 ♂, Collie, 28 Oct. 1982, R. Pigott (ASCU); 2 ♀, 1 ♂, Come-by-chance, 5 Mar. 1982, G. Baker, bred from eggs of *C. terminifera* (ASCU); 1 ♀, Condobolin, 2 Nov. 1934, *C. terminifera* eggs (ASCU); 2 ♀, Condobolin, 13 Oct. 1982, R.G. Pigott, bred from eggs of *C. terminifera* (WINC); 2 ♀, 4 ♂, Coonamble, 26 Jan. 1983 & 5 Mar. 1982, R. Pigott, G. Baker (ASCU); 1 ♀, Denman, 1 Mar. 1993, R. Pigott (ASCU); 6 ♂, Dubbo, 26 Oct. 1982, R. Pigott (ASCU); 12 ♀, Eurongilly, 26 Aug. 1992, R. Pigott, ex eggpods of *Gastrimargus musicus* (ASCU); 2 ♀, Forbes, 12 Apr. 1934, *C. terminifera* eggs (ASCU); 2 ♂, Fowlers Gap Res. Stn, 31.05S, 141.42E, 29 Nov.–2 Dec. 1981, I.D. Naumann (ANIC); 3 ♀, 3 ♂, Gilgandra, 20 Jan. 1982 & 17 Jan. 1985, R. Pigott (ASCU); 6 ♀, 5 ♂, Glen Innes, 14 Jan. 1938, M.A. Cameron (ASCU); 1 ♀, Gravesend, Apr. 1929, H.T. Nicholas (ANIC); 11 ♀, 3 ♂, Gundagai, 5 May and 21 Dec. 1992, R. Pigott, G. Baker (ASCU); 3 ♀, Hay, 20 Oct. 1994, R. Pigott (ASCU); 4 ♀, 5 ♂, Hillston, 11 Oct. 1982 & 17 Oct. 1984, R. Pigott (ASCU); 1 ♀, Jerilderie, 10 Jan. 1979, J. McGechan (ASCU); 1 ♀, Lachlan River, 15 km SW Euabalong, 28 Dec. 1976, Z. Liepa (ANIC); 1 ♀, 3 ♂, Manilla, 31 Mar. 1993, R. Pigott (ASCU); 10 ♂, Merriwa, 19 Jan. 1982, G. Baker (8-ASCU, 2-WINC); 1 ♀, Moree area, 30 Nov. 1976, E.M. Exley (ANIC); 4 ♀, Moree, 26 Jan. 1982, G. Baker (ASCU); 1 ♀, Mossgiel, 28 Feb. 1984, R. Pigott (ASCU); 1 ♀, Moulamein, 20 Oct. 1984, R. Pigott (ASCU); 1 ♀, 1 ♂, Mt Hope, 11 Oct. 1984, R. Pigott (ASCU); 1 ♀, Mt Magomonton, 28 Jan. 1982, R. Pigott (ASCU); 1 ♀, Muswellbrook, 15 Oct. 1935, eggs of *C. terminifera* (ASCU); 18 ♂, Myall Mundi, 14 Oct. 1954, K.H.L. Key, from egg-bed of *C. terminifera* (ANIC); 2 ♀, Narrandera, 19 Mar. 1993, R. Pigott (ASCU); 14 ♀, 15 ♂, 20 km NE Narromine, 26 Oct. 1982, R. Pigott (ASCU); 2 ♀, North Star, 12 Feb. 1992, R. Pigott (ASCU); 7 ♀, 12 ♂, Rydalmere, Nov. 1972–25 Mar. 1974, M. Staniland, ex culture of *C. terminifera* (ASCU); 4 ♀, 21 ♂, Scone, 8 Apr. 1981, 23 Dec. 1981, & 23–21 Oct. 1982, G. Baker (ASCU); 2 ♀, Temora, 30 Oct. 1934, *C. terminifera* eggs (ASCU); 23 ♂, Trangie, 1972, R. Lewis, ex eggs *C. terminifera* (ANIC); 1 ♀, Trangie Res. Stn, ground net, 4 Nov. 1979 (ANIC); 4 ♀, 2 ♂, Trida, 17 Oct. 1984, R. Pigott (ASCU); 3 ♀, 17 ♂, Wagga Wagga, May 1931, Feb. 1945, from grasshopper eggs (ASCU); 1 ♀, Walgett, 28 Jan. 1982, G. Baker (ASCU); 1 ♂, Warren, 26 Feb. 1982, R. Pigott (ASCU); 2 ♀, 7 ♂, Weethalle, 27 Jan. 1993, R. Pigott (ASCU); 1 ♀, Wollomombi, 13 Feb. 1982, G. Baker (ASCU); 3 ♀, Yetman, Sep. 1934, eggs of *C. terminifera* (ASCU). **Victoria:** 11 ♀, 4 ♂, Mildura, 24 Dec. 1934, ex eggs of *C. terminifera* (VDAM). **South Australia:** 1 ♀, Coopers Creek at Innamincka, 27.24S, 140.40E, 14 Feb. 1989, Austin & Dangerfield (WINC); 9 ♀, Dingly Dell Camp, Oraparinna Creek, 31.21S, 138.42E, 4–10 Nov. 1987, I. Naumann, J. Cardale (ANIC); 3 ♀, 3 ♂, north Hawker, Sep. 1992, S.A. Field (WINC); 4 ♀, 4 ♂, Mambray Creek, 23 Sep. 1992, S.A. Field (WINC); 8 ♀, 2 ♀, Mt Plantagenet, 26 Oct. 1982, J.A. Walden (ASCU); 10 ♀, 17 ♂, Murray Bridge, 27 Feb. 1935, D.C. Swan, bred from eggs of *Chortoicetes terminifera*, (WINC); 4 ♀, Wilpena Pound Gap, 31.33S, 138.36E, 5–10 Nov. 1987, I. Naumann, J. Cardale (ANIC); 14 ♀, 3 ♂, Wilson, 8–10 Sep. 1992, R.J. Dysart (ASCU). **Western Australia:** 1 ♀, Mt Cooke, 40 km SE Armadale, 7–22 Dec. 1990, A.D. Austin, Banksia/Jarrah Forest (WINC). **Northern Territory:** 1 ♀, 58 km NbyW Alice Springs, 23.10S, 133.43E, 4 Jun. 1978, J.C. Cardale (ANIC); 1 ♂, 39 km E Alice Springs, 23.41S, 134.15E, 26 Sep. 1978, J.C. Cardale (ANIC).

Female

Length

3.6–3.7 mm (mean 3.65 mm).

Colour

Head and mesosoma black, metasoma dark brown, legs, mandibles and antennae light brown to yellow.

Head

Width between eyes $0.59\text{--}0.6 \times$ width of head in dorsal view; OOL 0.2–0.3 mm; LOL 0.25–0.28 mm; POL 0.44–0.46 mm; ocellar diameter 0.05–0.06 mm, $0.09\text{--}0.11 \times$ width between eyes; head with fine sparse moderately short pilosity; occiput faintly strigose; posterior vertex smooth and shiny, with scattered sparse punctation becoming slightly denser on medial vertex to moderately dense on dorsal frons; ventral frons smooth and shiny, with moderately sparse scattered punctation; malar region with faint striae radiating from lateral clypeus; malar space $0.63\text{--}0.73 \times$ as long as eye height; interantennal process short, with well-developed lateral carinae, which continue around antennal sockets, not onto frons; clypeus moderately well produced between lateral points; anteclypeus defined by smooth, raised marginal area; mandibles smooth, lower tooth $0.2\text{--}0.4 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine and sparse becoming slightly coarser on lateral pronotum; dorsal pronotum with transverse strigosity; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum smooth anteriorly, becoming punctate-reticulate posteriorly; pronotal shoulders prominent, defined by transverse carina; anterior scutum smooth and shiny with scattered punctation; posterior scutum with fine to medium-sized moderately dense punctation, lateral scutum sculpturing smooth and shiny with scattered punctation; notauli well defined, crenulate; scutellum with moderately dense punctation, no lateral spines defined; dorsellum broad, only slightly raised above level of lateral metanotum, not emarginate; mesopleuron with moderately fine punctate-reticulation; mesosternum smooth and shiny, with scattered punctation; propodeum $0.5\text{--}0.54 \times$ as long as wide, rugose-reticulate about medial longitudinal furrow, with moderately sparse lateral pilosity absent, postero-lateral area rounded; indentation about nucha.

Wings

Lightly infusate, with light brown, short setae; stigmal spot defined as translucent to slightly opaque area, without stigmal vein defined.

Metasoma

$1.8\text{--}2.0 \times$ as long as wide, moderately broadly rounded, with fine, sparse lateral pilosity; T1 $0.64\text{--}0.78 \times$ as long as upper anterior width, $0.64\text{--}0.78 \times$ as long as lower anterior width, rugose-reticulate with longitudinal trend; T2 longitudinally strigose; T3 longitudinally striate to strigose; T4 longitudinally strigose in anterior two-thirds, becoming smooth posteriorly, T5 either mostly smooth, with scattered punctation or with faint longitudinal striation; T6 punctate-reticulate; S1 rugose-reticulate; S2–S5 smooth with scattered fine punctation medially, becoming faintly strigose laterally, S2 with shallow transverse basal ridge; S2–S3 without felt lines or nodes.

Male

As for female except: legs and antennae often dark brown; posterior vertex often with moderately faint transverse striae; medial vertex sometimes with faint longitudinal strigosity; medial anterior scutum with rugosity or punctation; tyloid defined on outer antennal segment

5; some males have propodeum with very slight indentation either side of nucha; metasoma more rounded at apex, giving a stout, broad, rounded appearance.

Distribution

This species is widely distributed in the eastern half of the continent, south of the Tropic of Capricorn. It is also known from two sites in south-western Western Australia (Fig. 8.78).

Hosts

Aiolopus thalassinus (Farrow 1982), *Chortoicetes terminifera*, *Gastrimargus musicus*, *Locusta migratoria* (holotype), *Oedaleus australis* (Farrow 1982) (see Tables 4.2 and 4.3).

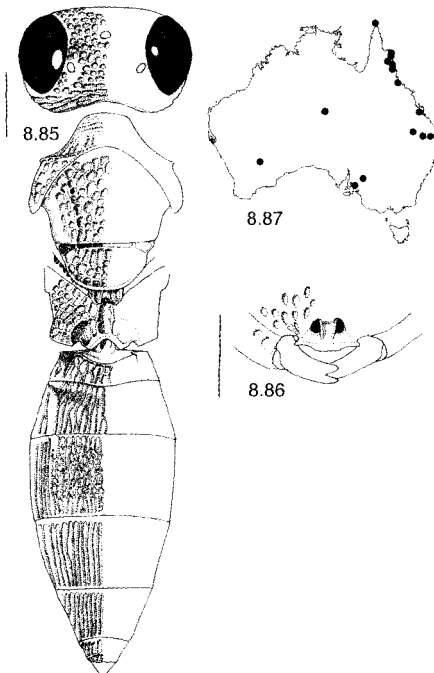
Comments

This is probably the most commonly collected species of *Scelio* in Australia and it is of considerable economic significance because of the pest status of its hosts. The male of this species has previously not been described. It is here associated based on material reared by M. Staniland, R. Pigott and R. Dysart (ASCU). Apart from the material listed above, we have examined hundreds of other specimens from localities in NSW (in ASCU), the collection data for which is not presented. It is the sister species to *S. erythropus* + *S. petilus*, which all have the mesosternum sparsely punctate. It can be distinguished from these two species by having clearly defined notauli, reduced sculpturing of the anterior scutum, and the propodeum not indented about the nucha.

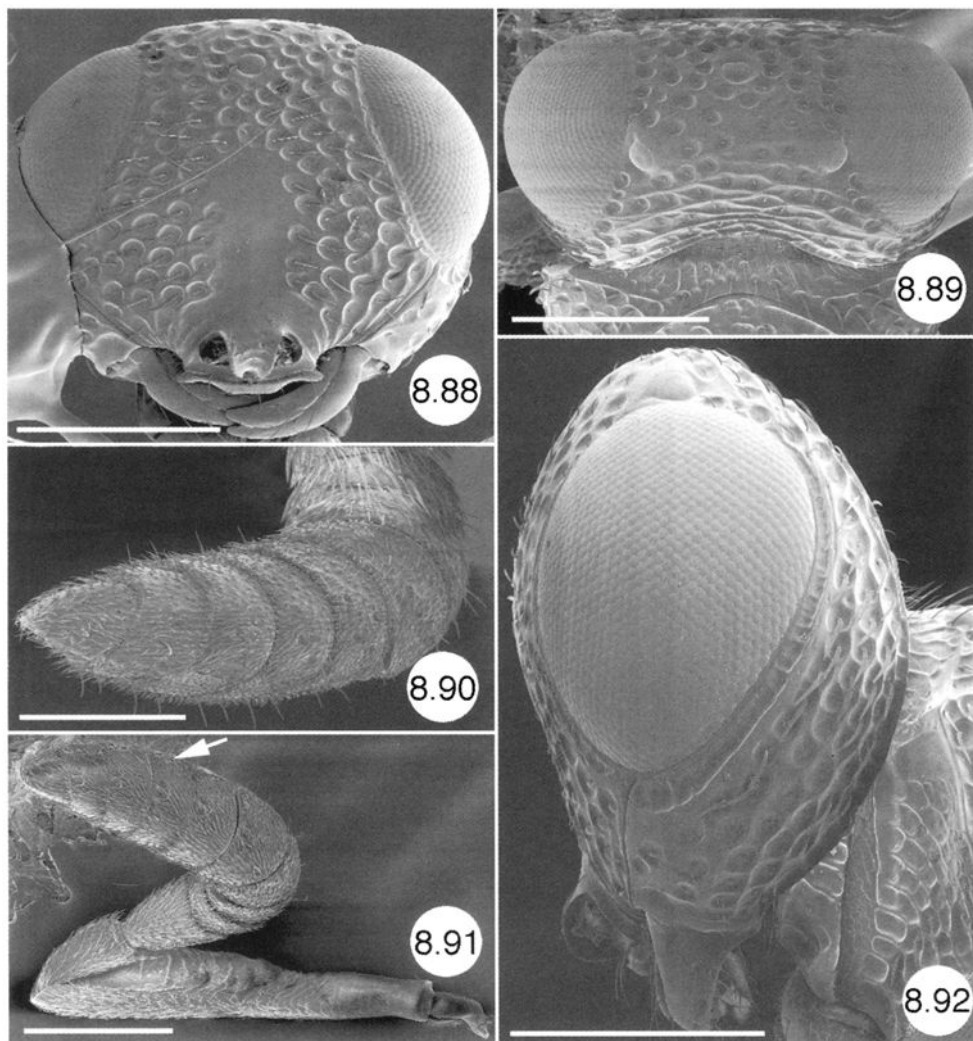
SCELIO FULVITHORAX DODD

(Figs 8.85–8.96)

Scelio fulvithorax Dodd, 1927: 149.- Galloway, 1976: 105; Galloway & Austin 1984: 10; Johnson, 1992: 480.



Figs 8.85–8.87. *Scelio fulvithorax* Dodd: 8.85. ♀ Holotype, dorsal habitus. 8.86. ♀ Holotype, lower anterior head, showing punctate malar region. 8.87. Distribution map. Scale lines: 0.25 mm.



Figs 8.88–8.92. *Scelio fulvithorax* Dodd, ♀: **8.88.** Anterior head. **8.89.** Dorsal head. **8.90.** Antennal clava. **8.91.** Antenna, with specialised sensillum arrowed. **8.92.** Lateral head. Scale lines: 8.88, 8.89, 8.92, 0.4 mm; 8.91, 0.2 mm; 8.90, 0.1 mm.

Material examined

Holotype

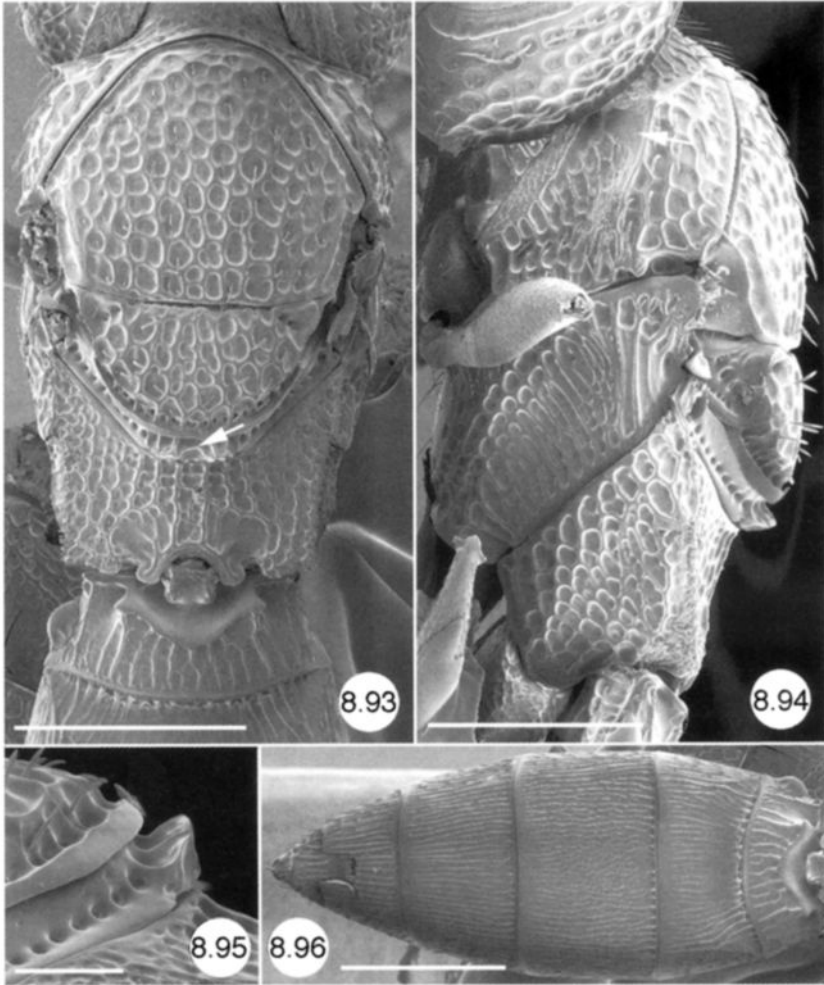
♀, Queensland, 'Kuranda, Q. March 1921, F.P.D.' (SAMA).

Paratype

Queensland: 1 ♀, same data as holotype (ANIC).

Other material examined

Queensland: 1 ♀, Bunya Mountains, 15 Apr. 1927, A.P. Dodd (ANIC); 1 ♀, Chillagoe, road to Mungana, 8 Apr. 1992, E.C. Dahms, G. Sarnes (QMBA); 10 ♀, Chinchilla, Feb. 1929,



Figs 8.93–8.96. *Scelio fulvithorax* Dodd, ♀: **8.93.** Dorsal mesosoma and T1, with emargination of dorsellum arrowed. **8.94.** Lateral mesosoma. **8.95.** Lateral metanotum, with raised dorsellum. **8.96.** Dorsal metasoma. Scale lines: 8.93, 8.96, 0.5 mm; 8.94, 0.4 mm; 8.95, 0.1 mm.

A.P. Dodd (ANIC); 1 ♀, Davis Creek NP, 10 km E Mareeba, 18 Feb. 1984, L. Masner, sweep (CNCI); 1 ♀, Kuranda, Mar. 1921 (ANIC); 1 ♀, 3 km E Mareeba, 22 Apr. 1987, E.C. Dahms, G. Sarnes (QMBA); 1 ♀, 15 km NE Mareeba, 7 Jan. 1985, Storey and Titmarsh (ANIC); 2 ♀, 3.5 km SWbyS Mt Baird, 15.01S, 145.07E, 3–5 May 1981, I.D. Naumann (ANIC); 1 ♀, Mt Cook Nat. Pk, 15.29S, 145.16E, 10–12 May 1981, I.D. Naumann (ANIC); 1 ♀, Mt Webb Nat. Pk, 15.04S, 145.07E, 27–20 Apr. 1981, I.D. Naumann (ANIC); 1 ♀, 6 km N Taroom, 25.36S, 149.46E, 17 Dec. 1997, C.J. Burwell, S. Evans (QMBA); 2 ♀, Townsville nr J. Cook Uni, 14–15 Apr. 1988, E.C. Dahms, G. Sarnes (QMBA); 1 ♀, Thursday Island, 5 Sep. 1983, J. F. Donaldson, D-vac (ANIC); 17 ♀, Westwood, Feb. 1928, A.P. Dodd (ANIC). **South Australia:** 1 ♀, Mount Barker Summit, Nov. 1986, A.D. Austin, sweep net (WINC); 1 ♀, 79 km NNW Renmark, 33.21S, 140.24E, Calperum Station Bookmark Biosphere Reserve, 12–21 Dec. 1995, P.T., S. Dominelli & K.R. Pullen (ANIC). **Western Australia:** 2 ♀, Charnley River, 2 km SW Rolly Hill CALM

Site, 16.22S, 125.12E, 16–20 Jun. 1988, I.D. Naumann (ANIC); 1♀, 29 km SE by E Coolgardie, 31.07S, 121.24E, 11 Oct. 1981, I.D. Naumann, J.C. Cardale (ANIC); 1♀, near Swamp Mitchell Plateau Airfield, 14.47S, 125.49E, 18 May 1983, I.D. Naumann, J.C. Cardale (ANIC). **Northern Territory:** 3♀, 39 km E and 32 km WNW Alice Springs, 5–8 Oct. 1978, J.C. Cardale (ANIC).

Female

Length

3.6–4.4 mm (mean 4.0 mm).

Colour

Yellow to orange except head and funicle black, metasoma mid brown to orange.

Head

Width between eyes $0.44\text{--}0.47 \times$ width of head in dorsal view; OOL $0.01\text{--}0.03$ mm; LOL $0.21\text{--}0.27$ mm; POL $0.33\text{--}0.38$ mm; ocellar diameter $0.06\text{--}0.08$ mm, $0.12\text{--}0.15 \times$ width between eyes; head with coarse, stout pilosity on temples, becoming finer on vertex and face; occiput with longitudinal rugulosity; posterior vertex rugose-reticulate with transverse trend; medial vertex punctate; frons punctate; malar region punctate, with very short radiating striae ventrally; malar space $0.43\text{--}0.67 \times$ as long as eye height; interantennal process broad and short with lateral carina continuing around antennal socket, not onto frons; clypeus produced between lateral points, straight medially; anteclypeus defined by raised smooth area; mandibles smooth, lower tooth subequal to upper tooth, dorsal tooth absent.

Mesosoma

Pilosity coarse, stout, white on lateral pronotum, otherwise fine; dorsal pronotum virtually smooth; latero-dorsal pronotum punctate-reticulate; latero-ventral pronotum smooth anteriorly, becoming rugose-reticulate posteriorly; pronotal shoulders prominent, defined by transverse carina; scutum, punctate to punctate-reticulate, slightly smoother anteriorly; notauli weakly defined amongst sculpturing; scutellum punctate-reticulate, no lateral spines defined; dorsellum prominent, deeply emarginate, with postero-lateral points; mesopleuron obliquely striate, sometimes with smooth medial area; mesosternum virtually smooth with sparse punctuation; propodeum $0.40\text{--}0.44 \times$ as long as wide, rugose-reticulate, medial longitudinal furrow present, with fine short white pilosity laterally, postero-lateral area square; indentation about nucha present.

Wings

Moderately infusate in apical two-thirds, with fine dark setae; stigmal spot defined by darker infuscation, with short stigmal vein.

Metasoma

$2.16\text{--}2.26 \times$ as long as wide, with fine sparse pilosity; T1 $0.38\text{--}0.5 \times$ as long as upper anterior width, $0.24\text{--}0.32 \times$ as long as lower anterior width, longitudinally strigose; T2 longitudinally strigose; T3 striate laterally, reticulate medially; T4 longitudinally striate to strigose; T5 longitudinally striate; T6 punctate-reticulate; S1–S5 faintly strigose with scattered punctuation; S2 with basal transverse ridge; S2–S3 without felt fields or nodes.

Male

Unknown.

Distribution

This species is widely distributed across the continent, but is most commonly encountered in coastal Queensland (Fig. 8.87).

Host

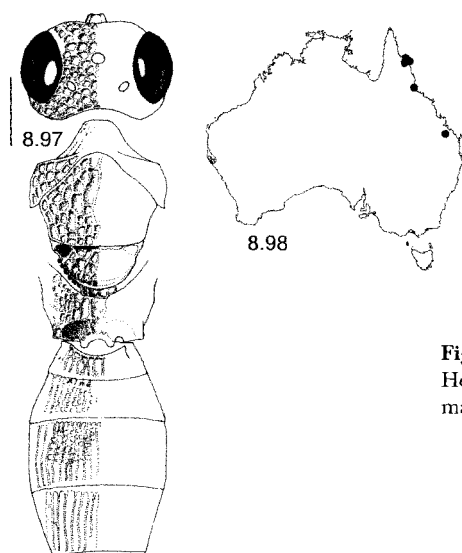
Unknown.

Comments

Scelio fulvithorax is the sister species of *S. contractus* + *S. pigotti* + *S. improcerus* + *S. nigriscutellum*, which along with *S. jokentae* all have the dorsellum prominent and deeply emarginate. It can be distinguished from these species by the notauli being poorly defined. Males for this species are inferred from the phylogenetic analysis as lacking antennal tyloids.

SCELIO GALLOWAYI DANGERFIELD & AUSTIN SP. NOV.

(Figs 8.97, 8.98)



Figs 8.97, 8.98. *Scelio gallowayi* sp. nov.: 8.97. ♀ Holotype, dorsal head to T4. 8.98. Distribution map. Scale line: 0.25 mm.

Material examined*Holotype*

♀, Queensland, '15.17S 145.10E 5 km WbyN Rounded Hill nr Hope Vale Mission Q 7 Oct. 1980 J.C. Cardale ex ethanol' (ANIC).

Paratypes

Queensland: 3 ♀, same data as holotype; 9 ♀, Atherton Tablelands, 7.1–7.5 km on road to Granite Gorge nr Mt Aunt, 1–4 May 1988, E.C. Dahms, G. Sarnes (QMBA); 2 ♀, Big Mitchell Ck, Mareeba-Malloy Road, 4 May 1967, D.H. Colless (ANIC); 3 ♀, 9.7 km N Ellis Beach, 17 Apr. 1987, E.C. Dahms, G. Sarnes (QMBA); 1 ♀, Expedition Range NP, 25.13S, 148.59E, 5 Mar. 1998, C.J. Burwell (QMBA); 4 ♀, 14 km WbyN of Hope Vale Mission, 15.16S, 144.59E, 7–10 May 1981, I.D. Naumann (ANIC); 3 ♀, 14 km WbyN of Hope Vale Mission, 15.16S, 144.59E, 8–10 Oct. 1980, J.C. Cardale (ANIC); 2 ♀, Mt Cleveland summit, 19.16S, 147.03E, Jan.–12 Mar. 1991, A. Graham (QMBA); 3 ♀, 3.5 km SWbyW of Mt Baird, 15.10S, 145.07E, 3–5 May 1981, I.D. Naumann (ANIC); 3 ♀, 1 km N of Rounded Hill, 15.17S, 145.13E, 5–7 May 1981, I.D. Naumann (ANIC).

Female

Length

3.4–4.5 mm (mean 3.8 mm).

Colour

Brown except legs and mesosoma, excluding scutellum and metanotum, orange-yellow.

Head

Width between eyes $0.46\text{--}0.49 \times$ width of head in dorsal view; OOL $0.05\text{--}0.06$ mm; LOL 0.18 mm; POL 0.26 mm; ocellar diameter $0.08\text{--}0.11$ mm, $0.19\text{--}0.21 \times$ width between eyes; head with fine, moderately long pilosity; occiput faintly strigose; posterior vertex rugose-reticulate with transverse trend; medial vertex punctate-reticulate; frons punctate-reticulate dorsally to rugose-reticulate ventrally; malar region with radiating striae, becoming slightly reticulate at lower level of eye and meeting horizontally above speculum; malar space $0.38\text{--}0.5 \times$ as long as eye height; interantennal process short and broad, with lateral carinae continuing around antennal sockets, not onto frons; clypeus produced and evenly convex between lateral points; anteclypeus defined by narrow carina; mandibles smooth, lower tooth $0.8\text{--}1.0 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, long, translucent; dorsal pronotum finely punctate; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum smooth anteriorly, becoming punctate to rugulose posteriorly; pronotal shoulders prominent, defined by transverse carina; scutum rugose-reticulate; notauli not clearly defined amongst sculpturing; scutellum rugose-reticulate, no lateral spines defined; dorsellum prominent, not to only slightly emarginate; mesopleuron virtually smooth medially, becoming rugulose-reticulate with foveolae laterally; mesosternum punctate-reticulate; propodeum $0.44\text{--}0.5 \times$ as long as wide, punctate-reticulate laterally, becoming rugose medially about medial longitudinal furrow, with very fine sparse pilosity laterally, postero-lateral area square; indentation about nucha present.

Wings

Lightly infusate, with fine, short setae; stigmal spot and stigmal vein defined as elongate translucent light-coloured swelling.

Metasoma

$1.67\text{--}2.2 \times$ as long as wide, with sparse, long, fine pilosity laterally; T1 $0.38\text{--}0.44 \times$ as long as upper anterior width, $0.28\text{--}0.32 \times$ as long as lower anterior width, longitudinally strigose; T2 longitudinally strigose with background reticulation; T3 rugose-reticulate medially, becoming strigose laterally; T4–T5 striate with background rugosity to rugose-reticulate throughout; T6 rugulose; S1–5 rugose-reticulate with scattered foveolae; S2 with shallow basal transverse ridge and poorly defined felt nodes.

Male

Unknown.

Distribution

This species is distributed along coastal Queensland (Fig. 8.98).

Host

Unknown.

Comments

Scelio gallowayi is similar to *S. flavigaster* but can be distinguished by the sculpturing and colour of the metasoma. One specimen from Lone Dingo, Mitchell Plateau, Western Australia (ANIC), is close to this species, but its pronotal shoulders are not so clearly defined and the scutellum and metanotum orange in colour. This specimen may represent a new species or the extreme end of variability in these characters for *S. gallowayi*. However, until further material is available it will not be possible to choose between these hypotheses. Males for this species are inferred from the phylogenetic analysis as lacking antennal tyloids.

SCELIO GOBAR WALKER

(Figs 8.99–8.109)

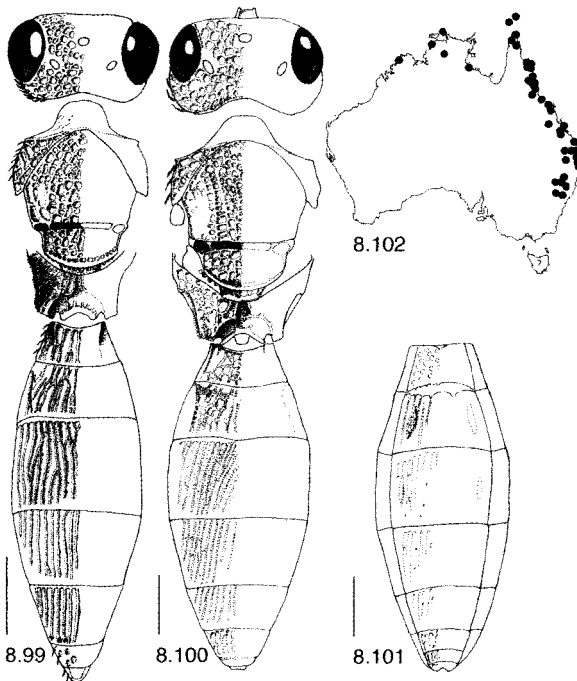
Scelio gobar Walker, 1839: 61.- Keiffer, 1910: 74; Dodd, 1913a: 135; Dodd, 1920: 347; Dodd, 1927: 137; Masner, 1965: 93; Galloway, 1976: 105; Galloway & Austin 1984: 10; Johnson, 1992: 480.

Macroteleia gobar: Dodd, 1913b:176; Kieffer, 1926: 543.

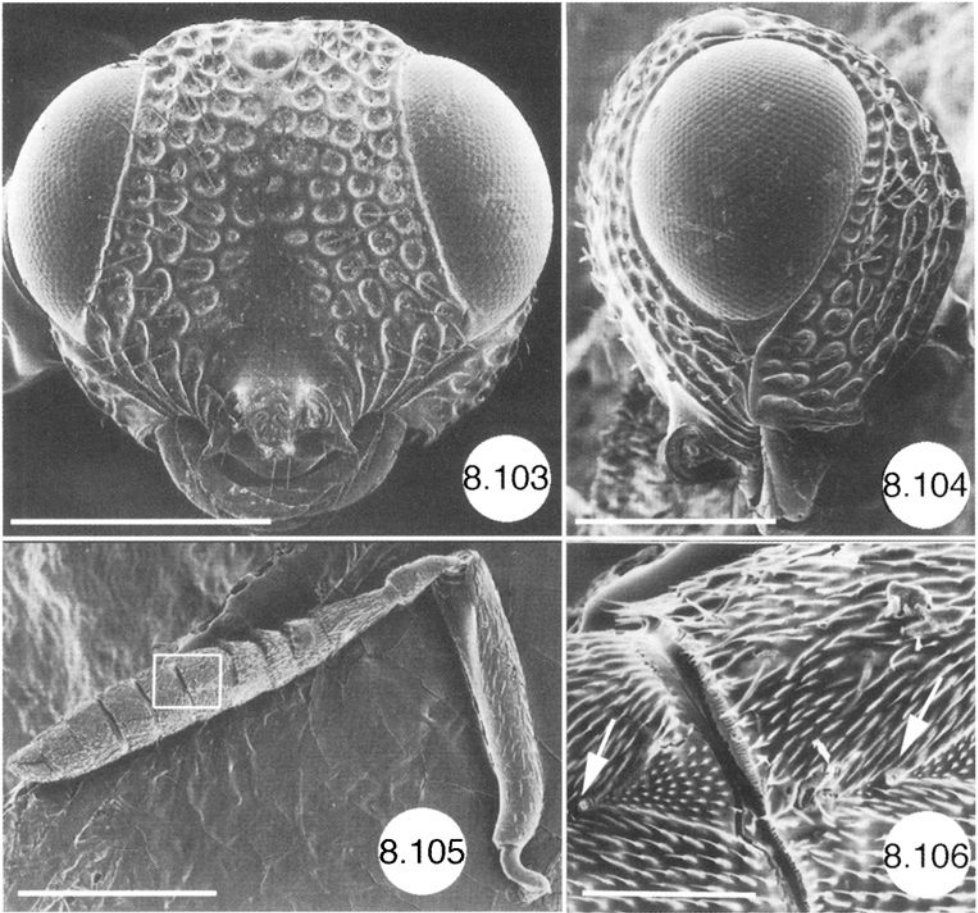
Scelio australis Froggatt, 1910: 34. - Girault, 1913b: 5; Dodd, 1913a: 135; Dodd, 1914b: 115; Dodd, 1915: 449; Dodd, 1920: 348; Kieffer, 1926: 342; Tillyard, 1926: 283; Dodd, 1927: 166 (synonymised with *S. bipartitus* Kieffer); Galloway, 1976: 104. **Syn. nov.**

Scelio froggatti Crawford, 1911: 268. - Girault, 1913b: 6; Dodd, 1913a: 136; Dodd, 1914b: 118; Kieffer, 1926: 340; Dodd, 1927: 166 (synonymised with *S. bipartitus* Kieffer); Masner and Muesebeck, 1968: 43; Galloway, 1976: 104, 105. **Syn. nov.**

Scelio ovi Girault, 1913b: 4. Dodd, 1913a: 136; Dodd, 1914b: 114; Dodd, 1927: 166 (synonymised with *S. bipartitus* Kieffer); Kieffer, 1926: 342; Tillyard, 1926: 283; Galloway, 1976: 104, 106. **Syn. nov.**



Figs 8.99–8.102. *Scelio gobar* Walker: 8.99. ♀ Holotype, dorsal habitus. 8.100. ♂, dorsal habitus. 8.101. ♂, ventral metasoma. 8.102. Distribution map. Scale lines: 0.25 mm.



Figs 8.103–8.106. *Scelio gobar* Walker, ♀ ♂: **8.103.** Anterior head. **8.104.** Lateral head. **8.105.** Antenna, with area of detail outlined. **8.106.** ♀, area of antennal detail, with specialised sensilla arrowed. Scale lines: 8.103, 0.5 mm; 8.104, 8.105, 0.4 mm; 8.106, 50 µm.

Material examined

Holotypes

♂ (*S. gobar*), Tasmania, ‘1307a V.D.L.’ (BMNH); ♀ (*S. australis*), Queensland, ‘Queensland, Childers, Parasite locust egg *Locusta danica* 1902’ (25.15S, 152.16E) (ASCU); ♀ (*S. froggatti* Crawford), ‘Pars eggs Plague locust Childers Queensld WWF’ (USNM); ♀ (*S. ovi*), no data label (QMBA).

Other material examined

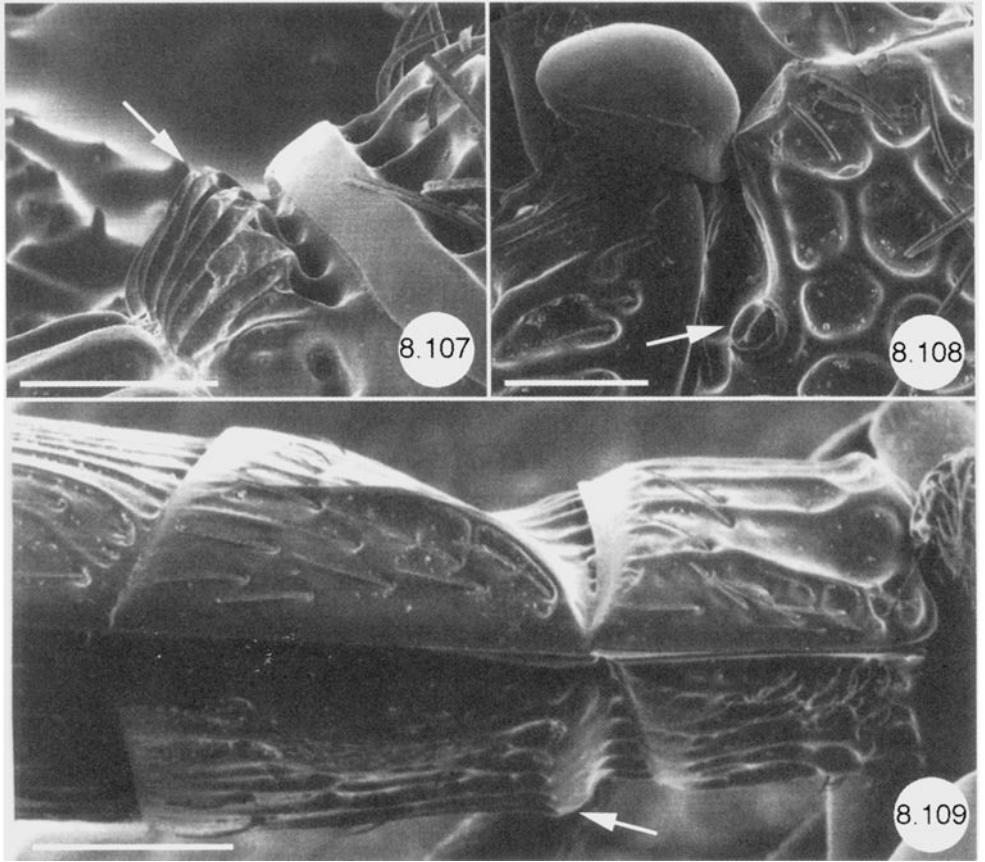
Queensland: 1 ♀, Alley Creek, 0.5 km W Gordonvale, 5 May 1988, E.C. Dahms, G. Sarnes (QMBA); 1 ♀, Annan R. at the Little Forks, 17–19 Oct. 1980, J.C. Cardale; 5 ♀, Batavia Downs, 18 Jun.–22 Jul. 1992, 11 Dec. 1992–16 Jan. 1993, 14 Feb.–8 Mar. 1993, 24 May–17 Jun. 1993, P. Zborowski, E. Nielsen, I. Naumann, M.T. (ANIC); 1 ♀, Blackall Ra, A.P. Dodd (ANIC); 1 ♀, Bottle Tree Scrub, Taroom-Cracow Rd, 25.33S, 150.08E, 14 Nov. 1996–13 Jan. 1997, D. Cook, pitfall (QMBA); 1 ♀, Bramston Beach via Innisfail, 15 Aug.–2 Sep. 1987, A. Walford-Huggins (ANIC); 11 ♀, 1 ♂, Brisbane, Feb. 1917, A.P. Dodd (ANIC); 1 ♀, 1 ♂,

Brisbane, DPI Indooroopilly, 8 Feb. 1977 (WINC); 3 ♀, Brisbane, 8 Dec. 1914, 23 May 1916, H. Hacker (QMBA); 6 ♀, Cairns, no date, Dodd (USNM); 1 ♀, Cape York, 10.41S, 142.32E, 20 Jun. 1993, I.D. Naumann, P. Zborowski (ANIC); 1 ♀, 1–6 km SE Chillagoe on road to Mareeba, 3 Apr. 1992, E.C. Dahms, G. Sarnes (QMBA); 1 ♀, Childers, W.W. Froggatt (ANIC); 8 ♀, Chinchilla, Feb. & Nov. 1926, Jan. 1927 & 1928, A.P. Dodd (ANIC); 3 ♀, 4 ♂, Chinchilla, Feb. 1930, J. Mann (ANIC); 8 ♀, Chinchilla, Mar. 1927, B.A. Smith (ANIC); 2 ♀, 6 km W Chinchilla, 10–24 Apr. 1987, G. Lithgow, M.T. (QMBA); 3 ♀, Craighoyle near Rockhampton, 5 Dec. 1983, K.G. Asher (ANIC); 1 ♀, Deadman Ck, 9 km S Proserpine, 10 May 1980, J.C. Cardale (ANIC); 1 ♀, Deeral, boat ramp, 8 Apr. 1987, E.C. Dahms, G. Sarnes (QMBA); 2 ♀, Eungella, W. Mackay, 30 Jan. 1975, B.K. Cantrell (WINC); 1 ♀, Gogango, 4 Jan. 1930, A.P. Dodd (ANIC); 31 ♀, 1 ♂, Gordonvale, Jan., Feb., May, Oct. & Dec. 1920, A.P. Dodd (ANIC); 1 ♀, Gordonvale, open forest, 7 Apr. 1987, E.C. Dahms, G. Sarnes (QMBA); 14 ♀, Heathlands, 11.45S, 142.35E, 15–26 Jan. 1992, I. Naumann, T. Weir, Yellow Dishes, 8 ♀, Herbert River, 1913, A.A. Girault (ANIC); 1 ♂, 14 km WbyN Hope Vale Mission, 8–10 Oct. 1980, 7–10 May 1981, I.D. Naumann (ANIC); 2 ♀, Indooroopilly DPI, 10–17 Dec. 1984, M.T. (ASCU); 3 ♀, 22 ♂, Innisfail, Nov. 1919, A.P. Dodd (ANIC); 8 ♀, Kingaroy, 16 Apr. 1927, A.P. Dodd (ANIC); 2 ♀, Kuranda, Mar. 1921, F.P. Dodd (ANIC); 1 ♀, Malanda, Mar. 1921 (ANIC); 12 ♀, 5 ♂, Mareeba, 17 Jun.–2 Sep. 1992, D.H. Habeck, M.T. (CNCI); 1 ♀, 3 km E Mareeba, 20 Apr. 1988, E.C. Dahms, G. Sarnes (QMBA); 1 ♂, Mt Ernest Is., 5 Apr. 1984, J.W. Turner (ASCU); 1 ♀, Mt Glorious S.F., 28 Feb.–9 Mar. 1984, L. Masner, M.T. (CNCI); 1 ♀, Mt Glorious, 24 May 1930, H. Hacker (ANIC); 1 ♂, Mt Glorious N.P., Feb. 1989, H. Howard (CNCI); 1 ♀, Mt Tamborine, Sep.–Oct. 1978, Sankowsky, M.T. (WINC); 1 ♀, Mt Tamborine, A.P. Dodd (ANIC); 3 ♀, Mt Webb Nat. Pk, 27–20 Apr. 1991, I.D. Naumann (ANIC); 22 ♀, Mossman, Apr. 1920, A.P. Dodd (ANIC); 1 ♀, Polly Creek, Seymour Range, 17.28S, 146.02E, Monteith, Janetzki, pitfall and intercept traps (QMBA); 3 ♂, Saibai Is., 29 Mar. 1984, J.W. Turner (ASCU); 1 ♀, Shiptons Flat, 17–19 Oct. 1980, J.C. Cardale (ANIC); 1 ♂, St Pauls, Moa Is., 10.11S, 142.16E, 11–16 Feb. 1986, Houston & Hamaeck (ASCU); 1 ♀, Townsville, James Cook Uni Campus, 21–26 May 1988, A.D. Austin, M.T. (WINC); 3 ♀, 4 ♂, Westwood, Oct. & Nov. 1927, & Feb. 1928, A.P. Dodd (ANIC); 1 ♀, Wongabel State Forest, 6 km S Atherton, 9 Jan.–10 Feb. 1984, Storey & Brown, M.T. (ASCU). **New South Wales:** 1 ♀, 1 ♂, Cassilis, 18 Feb. 1993, R. Pigott (ASCU); 2 ♀, 1 ♂, Denman, 30 Apr. 1992, R. Pigott (ASCU); 1 ♂, Gunnedah, 14 Dec. 1992, R. Pigott (ASCU); 1 ♂, Tamworth ‘Goonoo Goonoo’, 12 Mar. 1992, R. Pigott (ASCU); 7 ♀, Bundarra, 17 Mar. 1993, R. Pigott (ASCU); 2 ♀, Bundarra, Tienga Reach, 18 Jan. 1994, sweeping near *Oedaleus* and *Austroicetes* spp. R. Pigott (ASCU); 2 ♀, Manilla, 20 Jan. 1993, R. Pigott (ASCU); 1 ♀, Monga state Forest, 19–24 Jan. 1984, L. Masner (CNCI). **Western Australia:** 6 ♀, Mining Camp Mitchell Plateau, 14.49S, 125.50E, 9–19 May 1983, I.D. Naumann, J.C. Cardale, M.T. (ANIC). **Northern Territory:** 2 ♀, 3 km SSW Katherine, 14.30S, 132.15E, 12 Nov. 1979 (ANIC); 1 ♀, 9 ♂, Larrakeyah, 12.28S, 130.50E, 4 Aug.–5 Oct. 1991, M.S. Upton (ANIC, CNCI); 2 ♀, McArthur River, 2 km SSE Borroloola, 16.05S, 136.19E, 20 Apr. 1976 (ANIC). **Papua New Guinea:** 2 ♀, Terr. New Guinea, Hy.105, J.L. Froggatt (ANIC) (Brown legs). **No locality data:** 6 ♀ from eggs of *G. musicus*, emerged 5–8 Oct. 1937 (ANIC); 3 ♂, from eggs of *G. musicus*, emerged 5–8 Oct. 1937 (ANIC); 4 ♀, on one point (in poor condition), from eggs *L. danica* (ANIC); 16 ♀, on 8 points, from eggs of *G. musicus* emerged Dec. 1938 (ANIC); 9 ♀ bred from eggs of *G. musicus*, coll. in field cage 21 Jul. 1937, emerged 27 Sept. 1937 (ANIC); 3 ♂, bred from eggs of *G. musicus*, coll. in field cage 21 Jul. 1937, emerged 27 Sept. 1937 (ANIC); 6 ♀ without labels (ANIC); 31 ♂, without labels (ANIC).

Female

Length

4.0–5.5 mm (mean 4.7 mm).



Figs 8.107–8.109. *Scelio gobar* Walker, ♂: **8.107.** Lateral dorsellum, with prominence arrowed. **8.108.** Lateral pronotum and tegulae, with pronotal spiracle arrowed. **8.109.** Basal lateral metasoma, with transverse ridge arrowed. Scale lines: 8.107, 8.108, 0.1 mm; 8.109, 0.2 mm.

Colour

Dark brown except metasoma red-brown; legs, apical mandibles and basal antennae yellow.

Head

Width between eyes $0.46\text{--}0.53 \times$ width of head in dorsal view; OOL $0.03\text{--}0.06$ mm; LOL $0.18\text{--}0.21$ mm; POL $0.29\text{--}0.4$ mm; ocellar diameter $0.06\text{--}0.1$ mm, $0.14\text{--}0.2 \times$ width between eyes; head with pilosity generally coarse and translucent, slightly longer on temple; occiput virtually smooth; posterior vertex rugose-reticulate without transverse trend; medial vertex rugose-reticulate; dorsal and ventral frons punctate-reticulate; malar region with short radiating striae, becoming reticulate-rugose to punctate-reticulate immediately dorsal to interantennal process; malar space $0.37\text{--}0.68 \times$ as long as eye height; interantennal process with large lateral carinae; clypeus well produced between lateral points; anteclypeus not well defined; mandibles virtually smooth, sometimes with faint fine striations medially, lower tooth $0.7\text{--}0.8 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity coarse on lateral pronotum, medial scutum, scutellum, mesopleuron and mesosternum; dorsal pronotum virtually smooth; latero-dorsal pronotum rugose-reticulate;

latero-ventral pronotum punctate-reticulate; pronotal shoulders prominent, defined by transverse carina; anterior scutum rugose-reticulate; posterior scutum rugose-reticulate with foveolae; lateral scutum punctate-reticulate, with medial smooth patch; notauli poorly defined amongst sculpturing; scutellum rugose-reticulate medially, becoming punctate-reticulate laterally, without lateral spines; dorsellum moderately prominent, not emarginate; mesopleuron punctate; mesosternum punctate-reticulate; propodeum $0.42\text{--}0.57 \times$ as long as wide, rugose-reticulate, medial longitudinal furrow present anteriorly, with dense, fine, white pilosity laterally, postero-lateral area obliquely truncate; indentation about nucha present.

Wings

Lightly infusate, with short moderately coarse dense setae; stigmal spot and stigmal vein poorly defined by slightly darker infuscation.

Metasoma

$2.54\text{--}3.0 \times$ as long as wide, pointed apically, laterally with coarse sparse pilosity; T1 $0.75\text{--}0.87 \times$ as long as upper anterior width, $0.6\text{--}0.74 \times$ as long as lower anterior width, longitudinally strigose; T2–T3 longitudinally strigose; T4–T5 longitudinally striate; T6 foveolate; S1–S5 longitudinally striate, S4–S5 with medial smooth patch; S2 with shallow basal transverse ridge; S2 felt lines well defined and prominent.

Male

Length

4.6 mm.

Colour

Dark brown except mandibles, basal antennae and coxae medium to light brown, remainder of legs orange to yellow.

Head

Width between eyes $0.56 \times$ width of head in dorsal view; OOL 0.05 mm; LOL 0.26 mm; POL 0.41 mm; ocellar diameter 0.11 mm, $0.23 \times$ width between eyes; head with moderately coarse pilosity; occiput with irregular longitudinal strigosity; vertex and frons reticulate-punctate; malar region irregularly striate-reticulate; malar space $0.5 \times$ as long as eye height; interantennal process with lateral carinae continuing around antennal sockets, not onto frons; clypeus produced and evenly convex between lateral points; anteclypeus defined by raised smooth marginal area; mandibles smooth, lower tooth $0.8 \times$ upper tooth, dorsal tooth absent; antennal segment 5 with elongate tyloid present.

Mesosoma

Pilosity moderately coarse on lateral pronotum, medial scutum and scutellum; dorsal pronotum with fine reticulation; latero-dorsal pronotum with coarse reticulate-punctuation; latero-ventral pronotum punctate-reticulate with smooth area anteriorly; pronotal shoulders prominent, defined by transverse carina; scutum evenly punctate-reticulate; lateral scutum punctate-reticulate; notauli defined as crenulate furrows; scutellum punctate-reticulate, no lateral spines defined; dorsellum moderately prominent, not emarginate; mesopleuron with moderately fine punctate-reticulation; mesosternum with moderately coarse punctate-reticulation; propodeum $0.45 \times$ as long as wide, with punctate-reticulate lateral sculpturing, medial longitudinal furrow present, with fine lateral pilosity, postero-lateral area square; indentation about nucha present.

Wings

Moderately infusate, with light coloured fine setae; stigmal spot poorly defined as translucent buff-coloured area, with tubular infusate stigmal vein.

Metasoma

2.35 × as long as wide, with fine sparse pilosity; T1 0.96 × as long as upper anterior width, 0.58 × as long as lower anterior width, reticulate with longitudinal trend; T2 longitudinally strigose; T3 longitudinally strigose with background reticulation; T4–T6 longitudinally strigose with scattered foveolae; S1–S5 with longitudinal strigosity, S2 with basal transverse furrow and carina; S2–S3 with raised felt nodes defined.

Distribution

Scelio gobar is broadly distributed across northern and eastern coastal Australia as far south as Sydney. It is also recorded from Papua New Guinea (Fig. 8.102).

Hosts

Gastrimargus musicus (on label as *L. danica*) (holotype), *Locusta migratoria* (Girault 1913b), *Chortoicetes terminifera* (Baker *et al.* 1996), collected near *Oedaleus* and *Austroicetes* spp. by R. Pigott (see Tables 4.2 and 4.3).

Comments

The synonymy of *S. australis* with *S. gobar* has been based on comparison of the type specimens with material (representing both sexes) reared from egg pods of *C. terminifera* collected at Childers, Queensland, by W.W. Froggatt. Females of *S. australis* had previously been synonymised with *S. bipartitus*; however, there are distinct morphological differences which separate these species. Male specimens are similar to those of *S. bipartitus*, but can be readily distinguished by the indentation on either side of the nucha and the mandibular sculpturing in *S. bipartitus*.

This species is one of the most commonly collected *Scelio* in Australia. It is reasonably distinct from all other species with females being distinguished by an elongate metasoma and T1, coarse silvery pilosity on the temples and pronotum, postero-lateral corners of the propodeum narrowed and obliquely truncate, the notauli being indistinct among the coarse sculpturing of the scutum, the malar region punctate with short striae ventrally, the basal mandible smooth, and the dorsellum only being slightly prominent. Some males, particularly those from Saibai, Mt Ernest and Moa Islands in north Queensland (ASCU), have the dorsellum more prominent. These key separately to the other male specimens, but they fall within the limits of *S. gobar* in every other respect.

Phylogenetic analyses (Figs 6.1, 6.2) consistently resolve *S. gobar* in a clade with five other species, *S. miki*, *S. pseudaustralis*, *S. setiger*, *S. varipunctatus* and *S. pambertoni*, although they are not defined by any unequivocal characters.

SCELIO GRBINI DANGERFIELD & AUSTIN SP. NOV.

(Figs 8.110, 8.111)

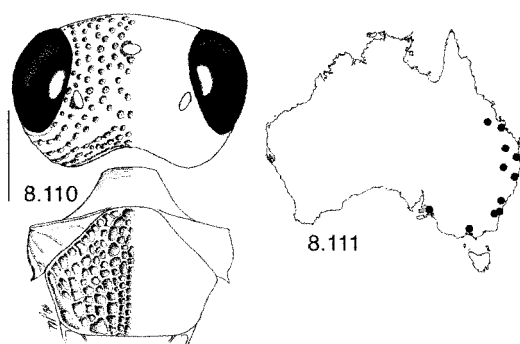
Material examined

Holotype

♀, Queensland, ‘Westwood Q. Feb, 1928 A.P.Dodd’ (ANIC).

Paratypes

Queensland: 2 ♀, same data as holotype; 2 ♀, Chinchilla, Jan. & Mar. 1928, A.P. Dodd (ANIC); 1 ♀, Brisbane, A.P. Dodd (ANIC). **New South Wales:** 1 ♀, Gravesend, 12 Jan. 1929,



Figs 8.110, 8.111. *Scelio grbini* sp. nov.:
8.110. ♀ Holotype, dorsal head to scutum. **8.111.** Distribution map. Scale line: 0.25 mm.

A.P. Dodd (ANIC); 1 ♀, Cabramatta, 11 Mar. 1926, M. Nikitin (BMNH); 1 ♀, Styx River State Forest, 900 m, Falls Rd, 22 km SE Wollomombi, 16 Feb.–7 Mar. 1994, K. MacGregor, F.I.T. (CNCI); 1 ♀, Monga, 14 Apr. 1970, J.C. Cardale (ANIC). **Australian Capital Territory:** 1 ♀, Black Mountain, 15 Apr. 1988, R. Farrow (ANIC). **Victoria:** 2 ♀, Belgrave, 26 Dec. 1926, A.P. Dodd (ANIC). **South Australia:** 1 ♀, Adelaide, disturbed scrubland, Apr.–Jun. 1986, G. Allen, P.T. (WINC); 1 ♀, Adelaide, Glen Osmond, Waite arboretum, Apr. 1998, Meo, Y.P.T. (WINC).

Female

Length

4.1–4.3 mm (mean 4.2 mm).

Colour

Generally orange except apical antennae, scutellum, dorsellum and metasoma light brown (tan), head (excluding mandibles) black; postero-medial scutum light brown in many specimens; ACT specimen dark brown except basal antennae, pronotum, propodeum and legs light brown.

Head

Width between eyes $0.49\text{--}0.52 \times$ width of head in dorsal view; OOL 0.03 mm; LOL 0.26 mm; POL 0.43 mm; ocellar diameter $0.06\text{--}0.08$ mm, $0.14 \times$ width between eyes; head with fine, short, sparse pilosity, virtually absent on vertex and temples; occiput finely strigose, occipital carina defined; posterior vertex punctate, with slight reticulate trend; medial vertex punctate; dorsal frons punctate; malar region and ventral frons, with well-defined radiating striae not clearly joining above speculum; malar space $0.48\text{--}0.5 \times$ as long as eye height; interantennal process short broad with lateral carinae, continuing around antennal sockets, not onto frons; clypeus well produced between lateral points with straight medial margin; anteclypeus defined by raised smooth area; mandibles smooth, lower tooth $0.8\text{--}1.0 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, short, sparse, slightly coarser on lateral pronotum; dorsal pronotum virtually smooth; latero-dorsal pronotum with radiating striae from antero-lateral point of pronotal shoulder; latero-ventral pronotum longitudinally strigose; pronotal shoulders prominent, well defined by transverse carina; scutum punctate-reticulate; notauli indistinct or poorly defined among sculpturing; scutellum punctate-reticulate, no lateral spines defined; dorsellum prominent, not emarginate; mesopleuron punctate to punctate-reticulate; mesosternum punctate; propodeum $0.45\text{--}0.5 \times$ as long as wide, rugose-reticulate with well-

defined transverse arched carina medio-posteriorly, medial longitudinal furrow shallowly defined, with fine sparse pilosity, laterally, postero-lateral area square to slightly rounded; indentation about nucha present.

Wings

Moderately infusate, with short moderately coarse setae; dark stigmal spot defined; stigmal vein absent.

Metasoma

2.35–2.38 × as long as wide, with very short fine sparse pilosity; T1 0.52–0.55 × as long as upper anterior width, 0.42–0.45 × as long as lower anterior width, longitudinally strigose; T2 longitudinally striate with smooth transverse basal furrow; T3 rugulose medially, becoming striate-reticulate laterally; T4 striate with medial smooth patch, T5 striate; T6 rugulose-reticulate; S1–5 longitudinally strigose; S2 with basal transverse ridge; S2–S3 with well-defined felt nodes.

Male

Unknown.

Distribution

This species is found along the east coast of Australia from Westwood on the Tropic of Capricorn to Adelaide, South Australia (Fig. 8.111).

Host

Unknown.

Comments

Scelio grbini is easily recognised by the radiating striae on the lateral pronotum and the transverse arched carina on the propodeum. It is resolved in the phylogenetic analysis as the sister taxon of *S. annae* (Fig. 6.2), and is named after Anthony Bogomir Grbin.

SCELIO IGNOBILIS DODD

(Figs 8.112–8.114)

Scelio ignobilis Dodd, 1927: 172.- Galloway, 1976: 105; Galloway & Austin 1984: 10; Johnson, 1992: 481.

Material examined

Holotype

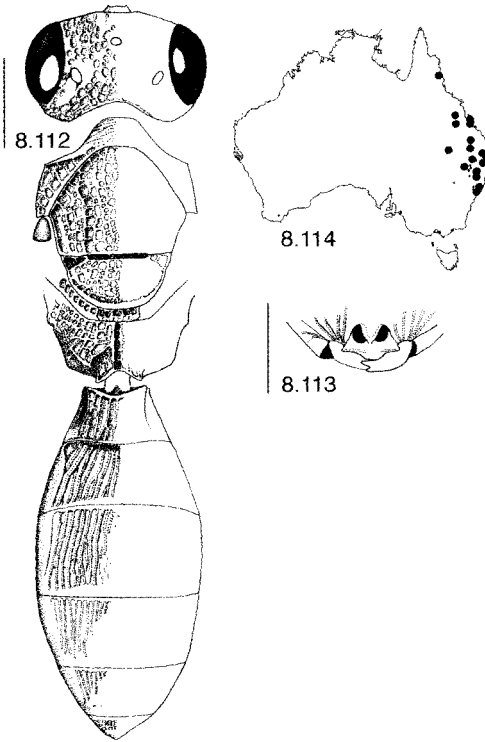
♀, Queensland, 'Malanda, N.Q. April 1921' (SAMA).

Paratypes

Queensland: 2 ♀, same data as holotype with date Mar. 1921 (ANIC).

Other material examined

Queensland: 1 ♀, same data as paratypes (ANIC); 1 ♀, Bald Mountain area via Emu Vale, 26–30 Jan. 1973, I. Naumann (ASCU); 2 ♀, Boggom via Taroom, 25.26S, 150.01E, Nov. 1995–Jan. 1997, Cook, Monteith (QMBA); 1 ♀, Brisbane, 24 Nov. 1976, Z. Boucek (BMNH); 1 ♂, Carr Creek, 18 km NNW Mareeba, 21 May 1980, I.D. Naumann, J.C. Cardale (ANIC); 1 ♀, Charleville, bank Warrego River, 9 Oct. 1974, I.D. Galloway (ASCU); 1 ♀, 2 km SE Drillham, 8 Oct. 1974, I.D. Galloway (ASCU); 2 ♀, Emerald, 6–18 Sep. 1981, D.A.H. Murray



Figs 8.112–8.114. *Scelio ignobilis* Dodd, 1927: 172.– Galloway, 1976: 105; Galloway & Austin 1984: 10; Johnson, 1992: 481.

(ASCU); 19 ♀, Gatton DPI Research Station, 21–28 Sep., 19–26 Oct. 1981 (WINC); 2 ♀, Goondiwindi, Oct. 1928, A.P. Dodd (ANIC); 2 ♀, Marlborough Ck, 2 km N Marlborough, 29 Jan. 1975, B.K. Cantrell (ASCU); 1 ♀, Mount Glorious, 25 Nov. 1976, Z. Boucek (BMNH); 1 ♀, Westwood, A.P. Dodd (ANIC). **New South Wales:** 3 ♀, 1 ♀, Bundarra, 3 Mar. 1993, R. Pigott (ASCU); 15 ♀, 3 ♂, Gloucester, 6 Apr. 1993, G. Baker ex *Aiolopus thalassinus tamulus* (ASCU, WINC); 2 ♀, Maitland, 4 Nov. 1953, E.F. Riek (ANIC); 1 ♀, Manilla, 15 Dec. 1992, R. Pigott (ASCU); 1 ♀, Mooni River, Oct. 1920, A.P. Dodd (ANIC). **Australian Capital Territory:** 1 ♂, Mt Gingera, 4 Feb. 1965, D.H. Colless (ANIC).

Female

Length

3.3–4.0 mm (mean 3.5 mm).

Colour

Dark brown except legs, mandibles and basal antennae yellow; metasoma may be medium brown.

Head

Width between eyes $0.52\text{--}0.56 \times$ width of head in dorsal view; OOL $0.03\text{--}0.06$ mm; LOL $0.18\text{--}0.21$ mm; POL $0.3\text{--}0.34$ mm; ocellar diameter $0.05\text{--}0.08$ mm, $0.11\text{--}0.16 \times$ width between eyes; head with fine, moderately short, sparse, translucent pilosity; occiput rugulose; posterior vertex punctate to punctate-reticulate, becoming smoother medially; medial vertex moderately sparsely punctate; dorsal frons punctate; ventral frons longitudinally strigose; malar region with radiating striae continuing onto ventral frons; malar space $0.44\text{--}0.49 \times$ as

long as eye height; interantennal process with lateral carinae continuing around antennal sockets; clypeus produced between lateral points; anteclypeus defined by smooth raised marginal area; mandibles smooth, lower tooth $0.5\text{--}0.67 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, moderately long, translucent; dorsal pronotum rugulose; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum smooth dorsally, becoming punctate to punctate-reticulate ventrally; pronotal shoulders moderately prominent, defined by transverse carina; scutum punctate; notauli defined by coarser deeper punctation; scutellum punctate, no lateral spines defined; dorsellum not prominent, only slightly raised above level of rest of metanotum, not emarginate; mesopleuron punctate; mesosternum moderately finely punctate; propodeum $0.45\text{--}0.51 \times$ as long as wide, rugose-reticulate, medial longitudinal furrow present, postero-lateral area obliquely sloping to rounded; indentation about nucha absent.

Wings

Lightly to moderately infusate, with moderately long golden to black setae; stigmal spot and stigmal vein virtually absent, sometimes visible as translucent trace.

Metasoma

$2.0\text{--}2.19 \times$ as long as wide, with fine pilosity; T1 $0.84\text{--}0.91 \times$ as long as upper anterior width, $0.72\text{--}0.86 \times$ as long as lower anterior width, longitudinally strigose-reticulate; T2–T5 longitudinally strigose; T6 punctate-reticulate with medial smooth patch; S1–S5 longitudinally strigose laterally, S3–S5 with broad medial smooth patch, S2 with shallow transverse basal ridge; S2 with sparsely punctate raised felt nodes defined.

Male

As for female except punctation generally coarser, legs and antennae darker in colour, tyloids absent on antennal segment 5.

Distribution

Scelio ignobilis is found from northern New South Wales to coastal north Queensland (Fig. 8.114).

Host

Aiolopus thalassinus (Baker *et al.* 1996) (see Tables 4.2 and 4.3).

Comments

Scelio ignobilis is the sister species of *S. planithorax*, which together are the sister group of the clade defined by the presence of male antennal tyloids (Fig. 6.2, node 9).

SCELIO IMPROCERUS DODD

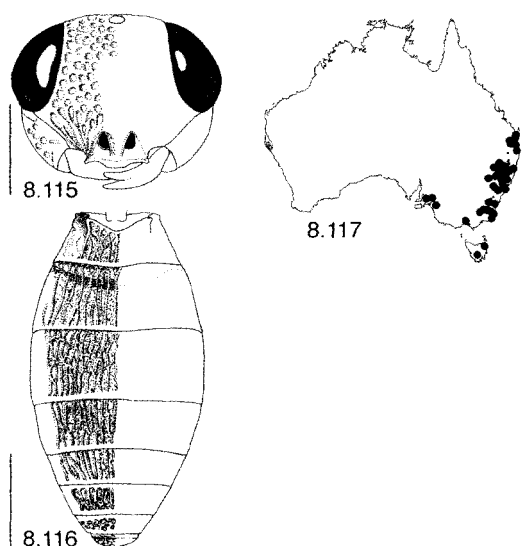
(Figs 8.115–8.125)

Scelio improcerus Dodd, 1927: 155.- Galloway, 1976: 105; Galloway & Austin 1984: 10; Johnson, 1992: 481.

Material examined

Holotype

♀, Queensland, 'Mt. Tambourine Queensland A. P. Dodd' (SAMA).



Figs 8.115–8.117. *Scelio improcerus*

Dodd: **8.115.** ♀ Paratype, anterior head.

8.116. ♂ Paratype, dorsal metasoma.

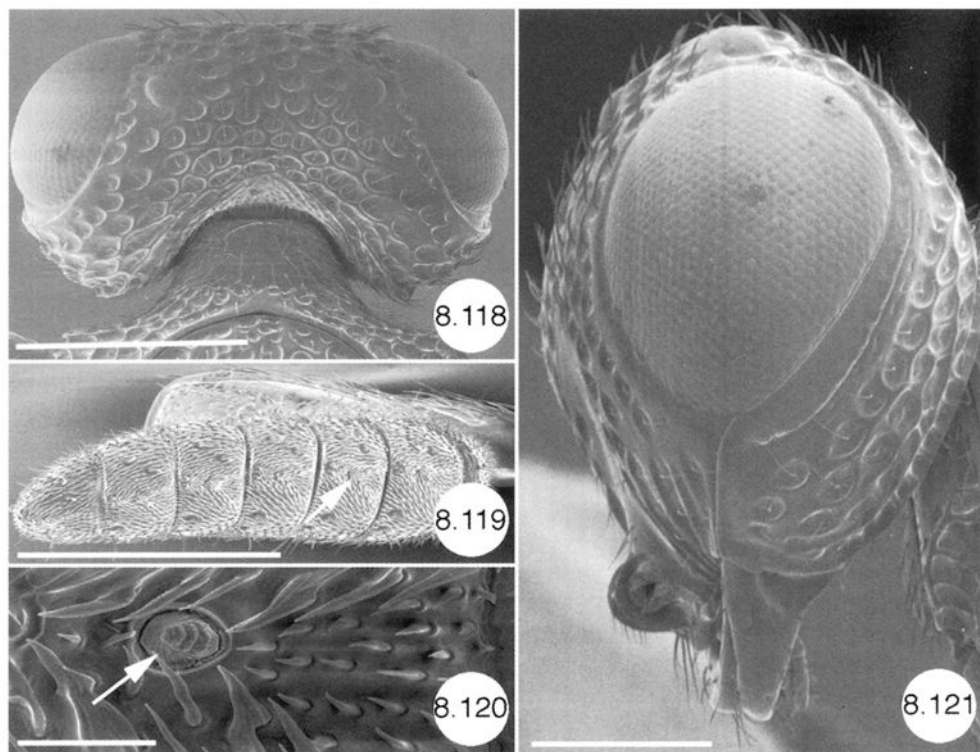
8.117. Distribution map of specimens examined during this study (large dots) and collection sites of Baker *et al.* (1996) (small dots). Scale lines: 0.25 mm.

Paratypes

Queensland: 3 ♀, same data as holotype (1 ♀ SAMA; 2 ♀, QMBA). 1 ♂, labelled Allotype (ANIC) belongs to species-group I.

Other material examined

Queensland: 6 ♀, same data as holotype (ANIC); 1 ♀, Blackall Ra, A.P. Dodd (ANIC); 1 ♀, Brisbane, 28 Jan. 1977, no collector (ASCU); 1 ♀, Buderim State Forest via Many Peaks, 2–5 Apr. 1972, S.R. Monteith (ANIC); 7 ♀, Chinchilla, Nov. 1926, 15 Jan. 1927, 21 Feb. 1927, Feb. 1932, A.P. Dodd (ANIC); 2 ♀, Gatton, 25 May 1981 and 28 Oct.–11 Nov. 1981, no collector (QDPI); 1 ♀, Indooroopilly, Dec. 1976, Z. Boucek (ASCU); 2 ♀, Mount Glorious NP, Feb. 1989, H. Howden (CNCI); 1 ♀, Toowoomba, L.F. Hitchcock (ANIC). **New South Wales:** 1 ♀, 2 ♂, Barraba, 19/21 Jan. 1993, R. Pigott (ASCU); 1 ♀, Bibbenluke, 21 Jan. 1983, G. Baker (ASCU); 11 ♀, Braidwood, 22 Dec. 1982, R.A. Farrow (ASCU); 1 ♀, Brown Mt, 10 Mar. 1961, E.F. Riek (ANIC); 4 ♀, 9 ♂, Bundarra, Jan.–Mar. 1993, R. Pigott (ASCU); 4 ♀, Cathcart, 21 Jan. 1983, G. Baker (ASCU); 1 ♀, Captains Flat, 26 Jan. 1982, G. Baker (ASCU); 1 ♀, Cassilis, 18 Feb. 1993, R. Pigott (ASCU); 2 ♂, Cooma, 27 Jan., 19 Mar. 1982, G. Baker (ASCU); 1 ♀, Dalgety, 9 Feb. 1983, G. Baker (ASCU); 1 ♀, Denman, 30 Apr. 1992, R. Pigott (ASCU); 1 ♀, Gunnedah, 14 Dec. 1992, R. Pigott (ASCU); 11 ♀, 2 ♂, Jerangle, 21 Jan. 1982, 31 Dec. 1993 & 30 Mar. 1994, G. Baker (ASCU); 1 ♀, Jindabyne, 22 Feb. 1969, Neboiss (MVMA); 2 ♀, Oberon, 19 Feb. 1982, G. Baker (ASCU); 1 ♀, Pittwater, 16 Mar. 1930, A.P. Dodd (ANIC); 2 ♂, Quirindi, 18 Mar. 1993, R. Pigott (ASCU); 1 ♀, Scotts Head, near Warrell Creek, 13 Feb. 1968, D.H. Colless (ANIC); Sunny Corner State Forest, 25 km EbyS Bathurst, 19 Apr. 1981, J.C. Cardale (ANIC); 1 ♂, Tamworth, 3 Feb. 1993, R. Pigott (ASCU); 1 ♀, Walcha, 11 Mar. 1979, 17 Jan. 1981, 17 Mar. 1982, G. Baker (ASCU); 1 ♀, Wincalda, 30 Oct. 1927, A.P. Dodd (ANIC); 1 ♀, Warrambungle NP, Camp Pincham, 10 Jan. 1985, D.B. McCorquodale (ANIC). **Australian Capital Territory:** 4 ♀, Canberra, Black Mountain, 7–12 Mar. 1980, A. Newton, M. Thayer (CNCI); 2 ♀, Black Mountain, Jan., Feb. 1982 (ANIC); 3 ♀, Black Mountain, Jan.–Mar. 1980, Jan. 1988, D.H. Colless (ANIC); 1 ♀, Black Mountain, Jan. 1982, J.R.T. Short, C. Tidemann (ANIC); 1 ♀, Black Mountain, 24 Apr. 1961, R.D. Hughes (ANIC); 2 ♀, Canberra, 18 Jan. & 10 Dec. 1980, D.F. Rentz (ANIC); 1 ♀, Molonglo R. 8 May 1930, L.F. Graham (ANIC); 1 ♀, 1 km N Mt Gingera, 35.35S, 148.46E,



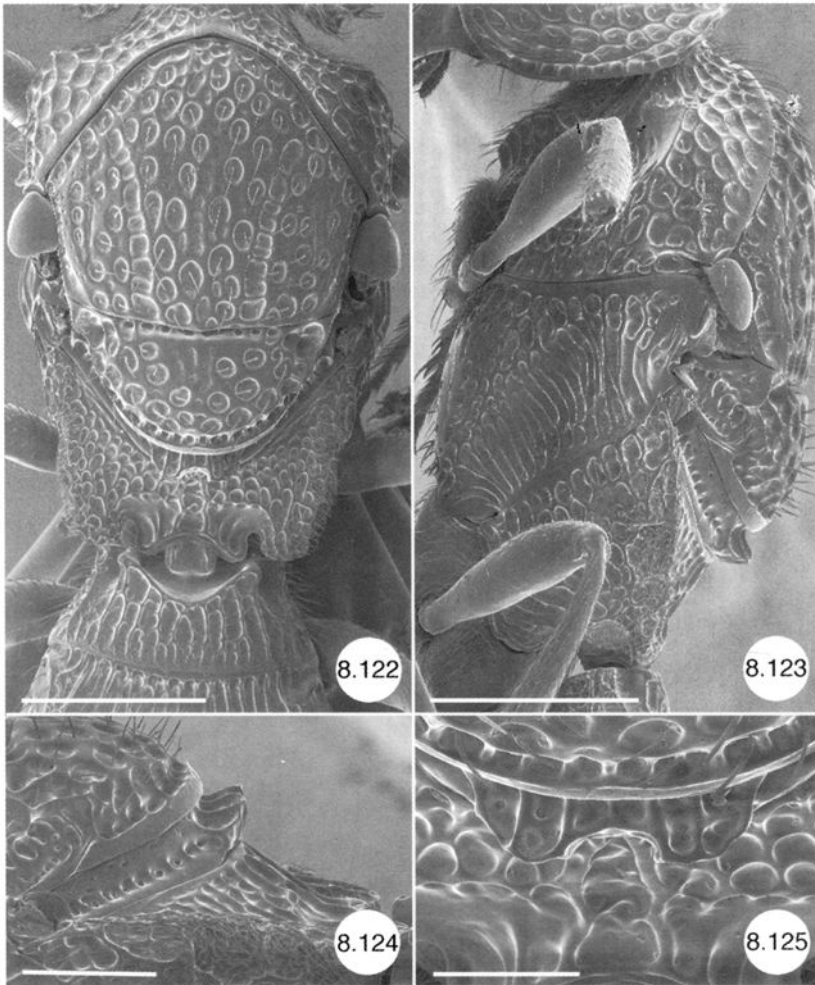
Figs 8.118–8.121. *Scelio improcerus* Dodd, ♀: **8.118.** Dorsal head. **8.119.** Antennal clava, with multiporous gustatory sensillum arrowed. **8.120.** Detail of multiporous gustatory sensillum, arrowed. **8.121.** Lateral head. Scale lines: 8.118, 0.4 mm; 8.119, 8.121, 0.1 mm; 8.120, 10 µm.

21 Feb.–10 May 1979, D.C. Rentz; 2 ♀, Mount Majura, 12 May 1961, 24 Apr. 1963, D.H. Colless (ANIC); 1 ♀, Piccadilly Circus, 35.22S, 148.48E, Feb.–Mar. 1984, J. Lawrence, T. Weir, M.-L. Johnson (ANIC). **Victoria:** 1 ♀, Baxter, 2 Feb. 1967, Neboiss (ASCU); 1 ♀, Karlo Ck, 21 km EbyN Cann River, 25 Feb. 1980, I.D. Naumann, J.C. Cardale (ANIC); 1 ♀, Latrobe R. Survey, Below Div. Weir, 16–18 Feb. 1973, no collector (ASCU); 1 ♀, Mitcham, Jan. 1988, C. Lai (CNCL); 1 ♀, Mitta Mitta Ck, 25 km NNW Omeo, 28 Feb. 1980, I.D. Naumann, J.C. Cardale (ANIC); 1 ♀, Dartmouth Survey, Mitta Mitta R., 6 Mar. 1973, R.D. (ASCU). **Tasmania:** 1 ♀, 1 km EbyN Herrick, 41.06S, 147.53E, 29–30 Jan. 1983, I.D. Naumann, J.C. Cardale (ANIC); 4 ♀, The Lea, 42.56S, 147.19E, 5 Feb. 1983, I.D. Naumann, J.C. Cardale (ANIC). **South Australia:** 1 ♀, Adelaide, Waite Campus, Glen Osmond, 27 Feb.–3 Mar. 1989, P. Dangerfield, M.T. (WINC); 20 ♀, Brecon, 10 km S Keith, 26 Jan. 1982, A.D. Austin (7 ♀, WINC; 12 ♀, ASCU; 1 ♀, Mylor, 28 Dec. 1973, Boy Scout Jamboree (WINC); 10 ♀, 5 km S Mylor, 13 & 19 Jan. 1980, 27 Dec. 1980 & 17 Feb. 1981, A.D. Austin (ASCU). **Unknown Locality:** 6 ♀, det. A.P. Dodd (ANIC); 5 ♀, Eggs from field cage of Plain Phaulacridium, 1937 (ANIC).

Female

Length

3.0–3.7 mm (mean 3.4 mm).



Figs 8.122–8.125. *Scelio improcerus* Dodd, ♀: **8.122.** Dorsal mesosoma and T1. **8.123.** Lateral mesosoma. **8.124.** Lateral metanotum. **8.125.** Antero-dorsal dorsellum. Scale lines: 8.122, 8.123, 0.4 mm; 8.124, 0.2 mm; 8.125, 0.1 mm.

Colour

Dark brown to black except legs and basal antennae light brown, metasoma mid brown to dark brown.

Head

Width between eyes $0.48\text{--}0.52 \times$ width of head in dorsal view; OOL $0.04\text{--}0.05$ mm; LOL $0.16\text{--}0.23$ mm; POL $0.26\text{--}0.36$ mm; ocellar diameter $0.06\text{--}0.08$ mm, $0.16\text{--}0.21 \times$ width between eyes; head with fine, moderately long, translucent pilosity; occiput with faint rugulosity; posterior vertex punctate-reticulate; medial vertex punctate; frons punctate; malar region punctate, with very short radiating striae at corners of clypeus; malar space $0.43\text{--}0.65 \times$ as long as eye height; interantennal process short and broad with lateral carinae continuing around antennal sockets, not onto frons; clypeus produced and convex between lateral points; anteclypeus defined by slightly raised marginal area; mandibles smooth, lower tooth $0.6\text{--}0.7 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, moderately long, translucent, sometimes with tan coloration dorsally; dorsal pronotum smooth or with faint rugulosity; latero-dorsal pronotum punctate-reticulate; latero-ventral pronotum rugose-reticulate; pronotal shoulders prominent, defined in lateral half by transverse carina; scutum with punctation; notauli moderately well defined by crenulate furrow; scutellum punctate, no lateral spines defined; dorsellum prominent, emarginate, with lateral lobes either pointed or rounded; mesopleuron transversely striate to strigose; mesosternum mostly smooth with sparse punctation; propodeum $0.27\text{--}0.44 \times$ as long as wide, rugose-reticulate, medial longitudinal furrow present, with fine short translucent pilosity laterally, postero-lateral area rounded; indentation about nucha present.

Wings

Lightly infusate, with short fine light setae; stigmal spot defined by infuscation, with short stigmal vein.

Metasoma

$1.94\text{--}2.32 \times$ as long as wide, with fine tan-coloured pilosity; T1 $0.41\text{--}0.5 \times$ as long as upper anterior width, $0.28\text{--}0.37 \times$ as long as lower anterior width, rugose-reticulate; T2 longitudinally strigose; T3 rugose-reticulate; T4–T5 longitudinally strigose; T6 rugose-reticulate; S1–S2 longitudinally strigose in basal half, smooth apically; S3–S5 smooth medially, becoming rugulose with fine punctation laterally, S2 with shallow basal transverse ridge; S2–S3 without felt lines or nodes.

Male

As for female except legs and antenna sometimes slightly lighter in colour; head and mesosome with denser punctate-reticulate sculpturing; antennal segment 5 slightly swollen but tyloid absent; notauli variable, from moderately well defined to indicated only by subtle change in sculpturing; mesosternum punctate or punctate-reticulate with a longitudinal trend; metasoma sometimes slightly more elongate.

Distribution

Scelio improcerus is widely distributed throughout south-eastern Australia, from just north of Brisbane to Adelaide and Tasmania (Fig. 8.117).

Host

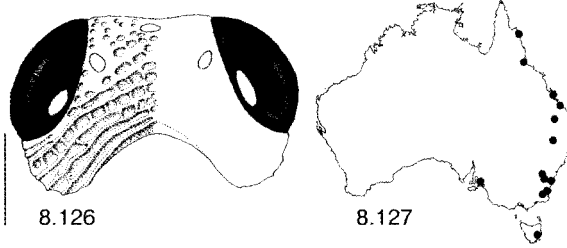
Phalacridium vitattum, *Macrotona australis* (Baker *et al.* 1985, 1996) (see Tables 4.2 and 4.3).

Comments

This species is the sister species of *S. nigriscutellum* and forms part of the clade which includes *S. jokentae*, *S. fulvithorax*, *S. contractus*, *S. pigotti* and *S. nigriscutellum*. This clade is defined by having a deeply emarginate dorsellum, although this is not an unequivocal character. Males of this species are often difficult to identify because of variation in the sculpturing of the scutum and mesosternum, and whether or not the notauli are clearly defined. Many specimens previously labelled *S. improcerus* have been accommodated under *Scelio* species 'B' and species-group 'I'. There is a great range of variation in sculpturing, which appears to be continuous between male *S. improcerus* (as described above) and species group 'I'. The latter group may represent males of a different species or, alternatively, may be conspecific with *S. improcerus*. However, this problem will not be resolved until comparisons can be made among series of reared species where the sexes can be accurately associated.

***SCELIO JOKENTAE* DANGERFIELD & AUSTIN SP. NOV.**

(Figs 8.126, 8.127)



Figs 8.126, 8.127. *Scelio jokentae* sp. nov.: 8.126. ♀ Holotype, dorsal head. 8.127. Distribution map. Scale line: 0.25 mm.

Material examined

Holotype

♀, Queensland, 'Chinchilla Q. March, 28 A.P. Dodd' (ANIC).

Paratypes

Queensland: 17 ♀, same data as holotype with dates Jan. 1928, Feb. 1928 & 1 Mar. 1930; 1 ♀, Cooloolo Forestry Area, E Gympie, Oct. 1978, I.D. Galloway (ASCU); 1 ♀, Emerald, 31 Dec. 1986, H. & A. Howden (ANIC); 1 ♀, Gogango, Mar. 1928, A.P. Dodd (ANIC); 3 ♀, Mt Cleveland summit, 19.16S, 147.03E, Jan.–12 Mar. 1991, A. Graham (QMBA); 1 ♀, Mt Moffatt Nat. Pk, 3 km SE of Park Headquarters, 25.04S 148.00E, 21 Nov. 1995, Irwin, Gaimari, Yeates, Burwell (QMBA). **New South Wales:** 1 ♀, Braidwood, Dec. 1981, R.A. Farrow (ASCU); 1 ♀, Cathcart, 21 Jan. 1983, G. Baker (ASCU); 1 ♀, Clyde Mountain Summit, 14 Jan. 1981, I.D. Naumann (ANIC); 2 ♀, Eucumbene, 20 Jan. 1983, G. Baker (ASCU); 1 ♀, Gravesend, 24 Jan. 1928, A.P. Dodd (ANIC); 3 ♀, Humula, 4 Dec. 1979, G. Baker (ASCU); 2 ♀, Tarago, 7 Feb. 1982, G. Baker (ASCU). **Tasmania:** 1 ♀, Collinsvale, 12 Mar. 1983, M.A. Williams, M.T. (ASCU). **South Australia:** 1 ♀ Belair NP 28 Jan.–4 Feb. 1996, J.T. Jennings, M.T. (WINC).

Other material examined

Queensland: 1 ♀, 3 km NE Mt Webb, 15.03S, 145.09E, 1–3 Oct. 1980, J.C. Cardale, M.T. (ANIC). **New South Wales:** 1 ♀, Eucumbene, 20 Jan. 1983, G. Baker (ASCU) (metasoma missing).

Female

Length

4.2–4.7 mm (mean 4.4 mm).

Colour

Dark brown except legs (excluding coxae) yellow to light brown.

Head

Width between eyes 0.42–0.46 × width of head in dorsal view; OOL 0.03–0.04 mm; LOL 0.24–0.27 mm; POL 0.28–0.36 mm; ocellar diameter 0.09–0.11 mm, 0.16–0.2 × width

between eyes; head with short fine pilosity; occiput strigose; posterior vertex transversely striate to punctate-reticulate with transverse trend; medial vertex punctate-reticulate; frons punctate-reticulate to punctate; malar region with short radiating striae, becoming punctate immediately dorsal of interantennal process; malar space $0.48\text{--}0.51 \times$ as long as eye height; interantennal process short, broad, with lateral carinae continuing around antennal sockets; clypeus well produced between lateral points; anteclypeus defined by raised smooth area; mandibles smooth, lower tooth $0.7\text{--}1.0 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, short, sparse, slightly coarser on lateral pronotum; dorsal pronotum transversely striate to punctate; latero-dorsal pronotum punctate-reticulate; latero-ventral pronotum longitudinally strigose anteriorly, becoming rugose-reticulate posteriorly; pronotal shoulders prominent, defined by transverse carina; scutum punctate to punctate-reticulate; notauli poorly defined amongst sculpturing; scutellum punctate-reticulate, no lateral spines defined; dorsellum prominent, emarginate, with latero-dorsal points; mesopleuron striate; mesosternum punctate; propodeum $0.39\text{--}0.45 \times$ as long as wide, rugulose-reticulate laterally with oblique striae medially about well-defined medial longitudinal furrow, with fine, short pilosity laterally, postero-lateral area square; indentation about nucha present.

Wings

Moderately infusate, with short fine setae; dark stigmal spot defined, with short stigmal vein.

Metasoma

$2.1\text{--}2.4 \times$ as long as wide, short fine sparse pilosity; T1 $0.45\text{--}0.5 \times$ as long as upper anterior width, $0.29\text{--}0.31 \times$ as long as lower anterior width, longitudinally strigose; T2 longitudinally strigose; T3 rugose-reticulate; T4–T5 longitudinally strigose; T6 rugose-reticulate; S1–S4 strigose-reticulate with foveolae; S5–S6 punctate; S2 with shallow basal transverse ridge; S2–S3 without felt lines or nodes defined.

Male

Unknown.

Distribution

Scelio jokentae is moderately widespread and is known from Tasmania, South Australia and along the east coast to northern Queensland (Fig. 8.127).

Host

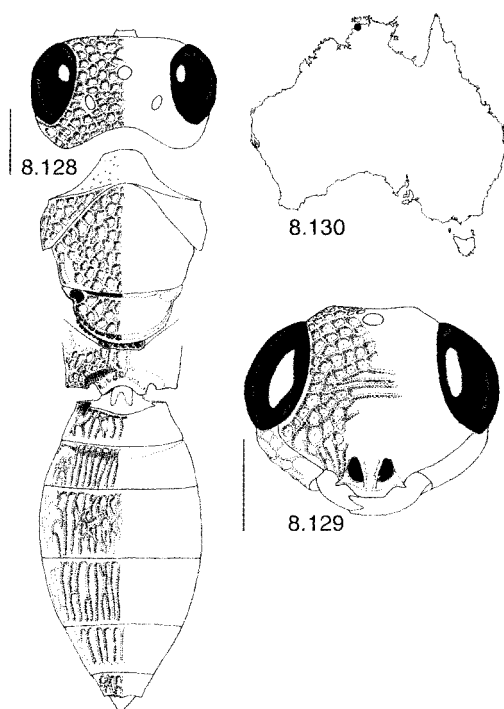
Unknown.

Comments

Scelio jokentae is the sister species of *S. fulvithorax* + *S. contractus* + *S. pigotti* + *S. nigriscutellum*, a group defined by having a deeply emarginate dorsellum, although this is not an unequivocal character. Males of this species are inferred from the phylogenetic analysis (Fig. 6.2) as lacking antennal tyloids. It is similar morphologically to *S. improcerus*, but can be distinguished by the transverse striae on the posterior vertex. One specimen from Mt Webb, Queensland (in ANIC), differs in having the coxae yellow, and because of this it has been excluded from the type series. This species is named after Jo Kent, an Honours student during 1996 in the Department of Crop Protection, the University of Adelaide.

***SCELIO JONI* DANGERFIELD & AUSTIN SP. NOV.**

(Figs 8.128–8.130)



Figs 8.128–8.130. *Scelio joni* sp. nov.:
8.128. ♀ Holotype, dorsal habitus.
8.129. ♀ Holotype, anterior head.
8.130. Distribution map. Scale lines:
 0.25 mm.

Material examined

Holotype

♀, Northern Territory, 'AUSTRALIA:NT; Darwin CSIRO, McWilliams Rd, 1–25.XII. 1993 mix Eucal. woodld, FIT S&J Peck 93–87' (CNCI).

Paratypes

Northern Territory: 2 ♀, same data as holotype.

Female

Length

3.6–3.75 mm (mean 3.65 mm).

Colour

Head including antennae black; mesosoma excluding propodeum light brown to dark orange; legs variable, from orange to light brown; propodeum and metasoma bright orange. The holotype also has the eyes bright orange.

Head

Width between eyes $0.5\text{--}0.51 \times$ width of head in dorsal view; OOL 0.08 mm; LOL 0.2 mm; POL $0.34\text{--}0.36$ mm; ocellar diameter 0.1 mm, $0.15\text{--}0.18 \times$ width between eyes; head with moderately coarse long translucent pilosity; occiput rugulose-reticulate, becoming strigose medially; vertex and frons coarsely punctate-reticulate; malar region with very short,

radiating striae becoming rugose-reticulate; malar space $0.53\text{--}0.55 \times$ as long as eye height; interantennal process short, moderately broad, with low lateral carinae continuing around antennal sockets; clypeus moderately produced, straight medially between lateral points; anteclypeus defined by raised smooth marginal area; mandibles smooth, lower tooth equal to upper tooth, dorsal tooth absent.

Mesosoma

Pilosity generally fine, long, translucent, but coarse on lateral pronotum; dorsal pronotum with punctation from associated pilosity; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum rugose-reticulate; pronotal shoulders prominent, defined by transverse carina; scutum rugose-reticulate; notauli poorly defined amongst sculpturing; scutellum rugose-reticulate, no lateral spines defined; dorsellum prominent, slightly emarginate, rounded laterally; mesopleuron finely punctate-reticulate; mesosternum with moderately coarse punctation; propodeum $0.35\text{--}0.44 \times$ as long as wide, rugose-reticulate, medial longitudinal furrow poorly defined, with sparse short fine translucent pilosity laterally, postero-lateral area roughly square; indentation about nucha present.

Wings

Lightly infusate in basal third, becoming slightly darker apically, with long fine setae; translucent light brown stigmal spot defined, with poorly defined stigmal vein.

Metasoma

$1.8\text{--}1.9 \times$ as long as wide, with moderately long fine pilosity; T1 $0.33\text{--}0.44 \times$ as long as upper anterior width, $0.25\text{--}0.32 \times$ as long as lower anterior width, longitudinally strigose; T2 longitudinally strigose; T3 rugose-reticulate medially, becoming strigose laterally and posteriorly; T4–T6 longitudinally strigose; T1–T6 rugose-reticulate at extreme lateral margins; S1–S5 coarsely rugose-reticulate; S2 without basal transverse ridge; S2–S3 with poorly defined felt nodes.

Male

Unknown.

Distribution

So far *S. joni* has only been collected near Darwin, Northern Territory (Fig. 8.130).

Host

Unknown.

Comments

Scelio joni is one of the few *Scelio* species which does not possess a basal transverse ridge on metasomal sternite two. Males for this species are inferred from the phylogenetic analysis (Fig. 6.2) as lacking antennal tyloids. It is named after Jonathan Richard Mayo.

SCELIO LITTORALIS DODD STAT. REV.

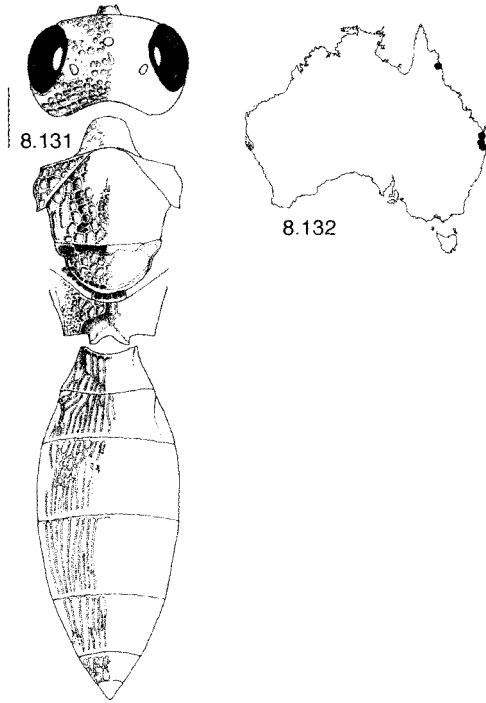
(Figs 8.131, 8.132)

Scelio perspicuus littoralis Dodd, 1927: 141.- Galloway 1976: 106.

Material examined

Holotype

♀, Queensland, 'Blackall Ra Queensland A.P. Dodd' (QMBA).



Figs 8.131, 8.132. *Scelio littoralis* Dodd:
8.131. ♀ Holotype, dorsal habitus.
8.132. Distribution map. Scale line:
 0.25 mm.

Paratype

Queensland: ♀, Mount Tamborine, Mar. 1928, A.P. Dodd (ANIC).

Other material examined

Queensland: 2♀, 2♂, Brisbane, May 1977, Feb. 1978 K.J. Houston (QDPC; 1♂, WINC); 5♀, Indooroopilly, 20 Dec. 1976, 12 Jan. 1977, Z. Boucek, M.T. (4, QDPC; 1, WINC); 1♀, 16 km up Davies Ck Rd via Mareeba, 18 Feb.–3 Mar. 1983, Storey, Titmarsh (QDPC); 5♀, 2♂, Mount Tamborine, Mar. 1928, A.P. Dodd (ANIC).

Female

Length

4.3–4.5 mm (mean 4.45 mm).

Colour

Dark brown, except legs and basal antennae yellow, metasoma mid brown.

Head

Width between eyes $0.51\text{--}0.52 \times$ width of head in dorsal view; OOL $0.04\text{--}0.05$ mm; LOL 0.23 mm; POL 0.39 mm; ocellar diameter $0.08\text{--}0.09$ mm, $0.13\text{--}0.16 \times$ width between eyes; head with fine short pilosity; occiput finely punctate-reticulate; posterior vertex coarsely punctate-reticulate; medial vertex with moderately sparse coarse punctation medially, denser laterally and posteriorly; dorsal frons punctate; ventral frons rugulose-reticulate; malar region with radiating striae, continuing dorsally to ventral edge of eye; malar space $0.49\text{--}0.54 \times$ as long as eye height; interantennal process moderately narrow, with lateral carina continuing onto frons; clypeus distinctly narrowly produced between lateral points, with straight medial margin; anteclypeus broad, defined by raised smooth marginal area which continues onto lateral points; basal mandible with reticulate sculpturing, lower tooth $0.3\text{--}0.57 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, long, translucent, sometimes with orange tinge on dorsal scutum; dorsal pronotum with irregular scattered rugulae and fine punctation; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum smooth anteriorly, becoming rugulose-reticulate postero-ventrally; pronotal shoulders prominent, defined by transverse carina; anterior scutum with broad smooth patch medially; posterior scutum coarsely rugose-reticulate, sometimes becoming finer medially; lateral scutum coarsely punctate to punctate-reticulate; notauli moderately defined by deeper punctures; scutellum rugose-reticulate, no lateral spines defined; dorsellum prominent, not emarginate; mesopleuron transversely strigose with background foveolae; mesosternum punctate-reticulate; propodeum short, $0.34\text{--}0.42 \times$ as long as wide, finely rugulose-reticulate laterally, becoming coarser medially about medial longitudinal furrow, with fine short white pilosity laterally, postero-lateral area square and pointed; indentation about nucha present.

Wings

Lightly infusate, with short light brown setae; stigmal spot well defined, elongate and infusate, with distinct infusate long stigmal vein.

Metasoma

$2.3\text{--}2.5 \times$ as long as wide, with short fine translucent pilosity, becoming yellow apically; T1 $0.70\text{--}0.75 \times$ as long as upper anterior width, $0.69\text{--}0.74 \times$ as long as lower anterior width, longitudinally strigose with background reticulation; T2 longitudinally strigose; T3–T5 longitudinally strigose laterally, becoming reticulate with longitudinal smooth patch medially; T6 rugose-reticulate; S1–S2 rugulose; S3–S5 smooth medially, becoming faintly strigose with scattered fine punctation laterally; S2 with basal transverse ridge and raised elongate finely setose felt nodes.

Male

The males have the same distinctive characters as the female, *viz.* the sculptured basal mandible, the lateral carinae of the interantennal process continuing onto the speculum, and the smooth or less sculptured antero-medial scutum.

Distribution

S. littoralis is known only from south-east and north Queensland (Fig. 8.132).

Host

Unknown.

Comments

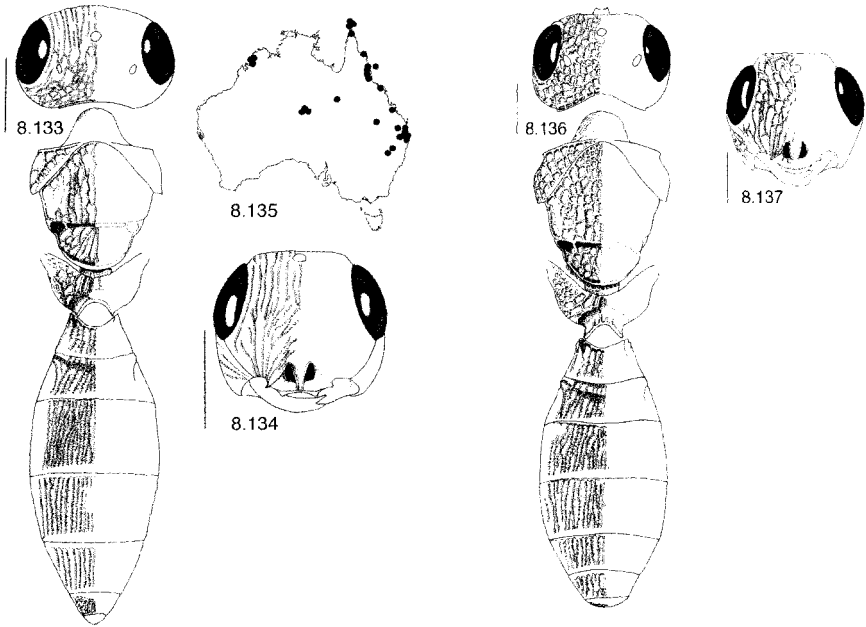
Scelio littoralis Dodd was originally described as a variety of *S. perspicuus* (Dodd 1927), with the species being recognised in part by its smooth anterior scutum. It was later given subspecific status by Galloway (1976). However, *S. littoralis* is clearly a distinct species and can be distinguished from *S. perspicuus* by the propodeum not being indented either side of the nucha, the interantennal process continuing onto the frons, and in having reticulate sculpturing on the basal mandible. In the phylogenetic analyses *S. littoralis* is the sister species of *S. asperatus* + *Sceliocerdo* + *S. nanocuspis*. Although they are not defined by any unequivocal synapomorphy, they all have the lateral carinae of the interantennal process continuing onto the speculum and a striate mesopleuron. This species is very similar to *S. asperatus*, but the latter can be distinguished by the sculpturing on the antero-dorsal scutum. If specimens intermediate in this character are forthcoming, then *S. asperatus* may eventually need to be treated as a junior synonym of *S. littoralis*.

SCELIO LOCUSTAE DODD STAT. REV.

(Figs 8.133–8.137)

Scelio locustae Dodd, 1914b: 117; Kieffer, 1926: 341; Dodd, 1927: 162 (synonymised with *S. flavicornis* Dodd); Galloway, 1976: 105. **Stat. rev.**

Scelio perplexus Dodd, 1914b: 117; Kieffer, 1926: 341; Dodd, 1927: 162 (synonymised with *S. flavicornis* Dodd); Galloway, 1976: 105. **Syn. nov.**



Figs 8.133–8.135. *Scelio locustae* Dodd:
8.133. ♀ Holotype, dorsal habitus. **8.134.**
 ♀ Holotype, anterior head. **8.135.** Distribution
 map. Scale lines: 0.25 mm.

Figs 8.136, 8.137. *Scelio locustae* Dodd, ♂, from
 Coonamble, NSW: **8.136.** Dorsal habitus.
8.137. Anterior head. Scale lines: 0.25 mm.

Material examined*Holotype*

♀ (*S. locustae*), Queensland, no data on specimen but is described by Dodd (1927) as being from Herbert River (SAMA); ♂ (*S. perplexus*), pointed specimen and slide mount of antennae and wings, no data label (SAMA).

Other material examined

Queensland: 1 ♀, Alley Creek 0.5 km W Gordonvale, 14 Apr. 1987, E.C. Dahms, G. Sarnes (QMBA); 1 ♀, Arcadia Valley, 9 Feb. 1975, R. Farrow (QDPC); 1 ♀, Archer Creek, 15 km WbyS Ravenshoe, 20 May 1980, I.D. Naumann, J.C. Cardale (ANIC); 1 ♀, Bowen, 27 Sep. 1950 E.F. Riek (ANIC); 1 ♀, Brandy Creek Rd, Cornway Range Station, 25 Apr. 1979, E. Dahms (QMBA); 1 ♀, Brisbane River, Tennyson, Mar. 1977, I.D. Galloway (QDPC); 2 ♀, Brisbane, A.P. Dodd (ANIC); 1 ♀, Charleville, Warrego River, 9 Oct. 1974, I.D. Galloway (QDPC); 6 ♀, Chillagoe, on road to Mareeba, 17.09S, 144.31E, 26 Mar.–4 Apr. 1992, E.C. Dahms, G. Sarnes (QMBA); 1 ♀, Chinchilla, Feb. 1930, A.P. Dodd (ANIC); 2 ♀, Dauan Is., 28 Mar. 1984, J.W. Turner (QDPC); 1 ♀, Eungella, W. Mackay, 30 Jan. 1975, B.K. Cantrell (QDPC); 5 ♀, Gatton DPI Research Station, 16–24 Mar. 1981 (QDPC); 1 ♀, Gogango,

28 Mar. 1931, A.P. Dodd (ANIC); 1 ♀, Gordonvale, Jan. 1920 (ANIC); 1 ♀, 16.3 km S Gordonvale, 18 Nov. 1979, LaSalle, Woolley, Dahms (QMBA); 3 ♀, near Gordonvale, 7, 14, 16 Apr. 1987, E.C. Dahms, G. Sarnes (QMBA); 2 ♀, Heathlands, 11.45S, 142.35E, 15–26 Jan. 1992, I. Naumann, T. Weir (ANIC); 1 ♀, Kowanyama, 26 Jul. 1982, J.F. Donaldson (QDPC); 1 ♂, 3 km E Mareeba, 20 Apr. 1988, E.C. Dahms, G. Sarnes (QMBA); 1 ♀, Mary Cairncross Park via Maleny, 11–15 Apr. 1985 (QDPC); 5 ♀, Mt Webb National Park, 15.04S, 145.07E, 27–20 Apr. 1981, I.D. Naumann (ANIC); 1 ♀, 2nd Mulgrave Range Crossing, Goldsborough Road, 2 Apr. 1976, I.D. Galloway (QDPC); 1 ♀, St George, 11 Oct. 1974, I.D. Galloway (QDPC); 1 ♀, St Lucia, 10 Mar. 1975, C. Mackenzie (QDPC); 1 ♀, 1 ♂, Sue Is., 8 Apr. 1984, J.W. Turner (QDPC); 1 ♀, Sunnybank, 1 Dec. 1951, E.F. Riek (ANIC); 1 ♀, Sunnybank, 2 Nov. 1967, J.H. Barrett (QDPC); 1 ♀, Tarome area, 16 Mar. 1975 (QDPC); 1 ♀, Tully Falls Rd, 31 Mar. 1976, I.D. Galloway (QDPC); 1 ♀, Turtle Islet, Lihau Reef, Coral Sea, 17.08S, 152.02E, 18 Jun. 1983, L. Hill (ANIC); 1 ♀, Willis Island, 2–3 Aug. 1978 (ANIC); Yorke Is., 22 Mar. 1984, J.W. Turner (QDPC). **New South Wales:** 7 ♀, 2 ♂, Coonamble, R. Pigott, V. Rajakulendran, 2–14 Jan. 1991, ex eggs of *Valanga irregularis* (ASCU); 2 ♀, Narrabri, 26–27 Jan. 1960, M.I. Nikitin (BMNH). **Western Australia:** 1 ♀, Charnley Riv., 12 km SW Rolly Hill CALM Site 25/2, 16.22S 125.12E, 16–20 Jun. 1988, I.D. Naumann (ANIC); 1 ♀, 'The Crusher' CALM Site 9/1, 4 km SbyW Mining Camp, Mitchell Plateau, 14.52S, 125.50E, 2–6 Jun. 1988, I.D. Naumann (ANIC); 2 ♀, Lone Dingo, Mitchell Plateau, 14.35S, 125.45E, 9–19 May 1983, I.D. Naumann, J.C. Cardale (ANIC); 1 ♀, 'Marun' CALM Site 8/4 Prince Frederick Harbour, 15.00S, 125.21E, 6–11 Jun. 1988, I.D. Naumann (ANIC). **Northern Territory:** 1 ♀, 10 km NbyE of Alice Springs, 23.37S, 133.54E, 6 Nov. 1979, I.D. Naumann (ANIC); ♀, 35 km NbyW Alice Springs, 23.22S, 133.48E, 27 May 1978, J.C. Cardale (ANIC); 3 ♀, Ellery Gorge, 85 km W of Alice Springs, 23.46S, 133.04E, 5 Nov. 1979, I.D. Naumann (ANIC); 11 ♀, Wigley Waterhole, 8 km N of Alice Springs, 23.38S, 133.53E, 29 May 1978, J.C. Cardale (ANIC).

Female

Length

3.6–4.7 mm (mean 4.2 mm).

Colour

Brown, except legs (excluding coxae) and antennal toruli dark yellow.

Head

Width between eyes $0.58\text{--}0.61 \times$ width of head in dorsal view; OOL $0.02\text{--}0.04$ mm; LOL 0.33 mm; POL 0.56 mm; ocellar diameter $0.07\text{--}0.08$ mm, $0.1 \times$ width between eyes; head with very coarse long white opaque pilosity, finer and translucent on medial vertex; occiput finely rugulose-reticulate; posterior vertex shallowly rugulose-reticulate; medial vertex rugose-reticulate; dorsal frons rugose-reticulate with longitudinal trend; malar region with well-defined radiating striae, continuing halfway up frons; malar space $0.5\text{--}0.66 \times$ as long as eye height; interantennal process pronounced, narrow, short, with lateral carinae continuing around antennal sockets; clypeus not produced, concave between lateral points; anteclypeus not defined; mandibles smooth, lower tooth $0.5\text{--}0.75 \times$ upper tooth, dorsal tooth well defined.

Mesosoma

Pilosity very coarse, long, white, opaque, some hairs blunt-tipped; dorsal pronotum finely punctate; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum smooth anteriorly, becoming rugose-reticulate posteriorly; pronotal shoulders prominent, defined by transverse carina; scutum rugose-reticulate; notauli not defined amongst sculpturing; scutellum rugose-reticulate to punctate-reticulate, no lateral spines defined; dorsellum prominently rounded, not emarginate; mesopleuron rugose-reticulate; mesosternum

rugose-reticulate; propodeum $0.35\text{--}0.36 \times$ as long as wide, rugose-reticulate about medial longitudinal furrow, with fine long pilosity laterally, postero-lateral area rounded; indentation about nucha absent.

Wings

Lightly infuscate, with light short setae; light-coloured opaque stigmal spot, with well-defined stigmal vein.

Metasoma

$2.2\text{--}2.3 \times$ as long as wide, with coarse fine pilosity laterally; T1 $0.78\text{--}0.95 \times$ as long as upper anterior width, $0.66 \times$ as long as lower anterior width, rugose-reticulate with longitudinal trend and background punctation; T2 longitudinally striate; T3 longitudinally strigose, with background reticulation; T4–T5 longitudinally striate; T6 rugose-reticulate; S1–S2 rugose-reticulate with background punctation, S2 becoming smoother posteriorly; S3–S5 smooth medially, strigose-reticulate laterally; S2 with basal transverse ridge and prominent felt fields; S3 with broad felt fields defined.

Male

Differing from the female as follows: clypeal margin produced and convex medially; pilosity coarse but slightly finer and more translucent; tyloid on antennal segment 5 absent, but with many small rounded basiconic sensilla on antennal segments.

Distribution

This species is widely distributed from northern Western Australia to Queensland and down the east coast into northern New South Wales (Fig. 8.135).

Host

Valanga irregularis (see Tables 4.2 and 4.3).

Comments

Scelio locustae is here removed from synonymy with *S. flavicornis* based on female and male specimens reared from *V. irregularis* at Coonamble, New South Wales. This material matches the female holotype of *S. locustae* and the male holotype of *S. perplexus*. Based on this association of the sexes, *S. perplexus* is here treated as a junior synonym of *S. locustae*. *Scelio locustae* is clearly different from *S. flavicornis* in that males have T2 and T3 coarsely strigose with background reticulation, and so the former has been reinstated as a valid species. Other specimens collected by J.W. Turner from islands in northern Queensland support the above proposed association of the sexes. The male holotype of *S. perplexus* differs from reared males in having small longitudinal striae on the clypeal margin. At this stage, this difference is assumed to be intraspecific.

This species belongs to a monophyletic group containing *S. borroloolensis*, *S. pilosus* and *S. setafascis* based on the presence of a dorsal mandibular tooth, an unequivocal character state for this clade.

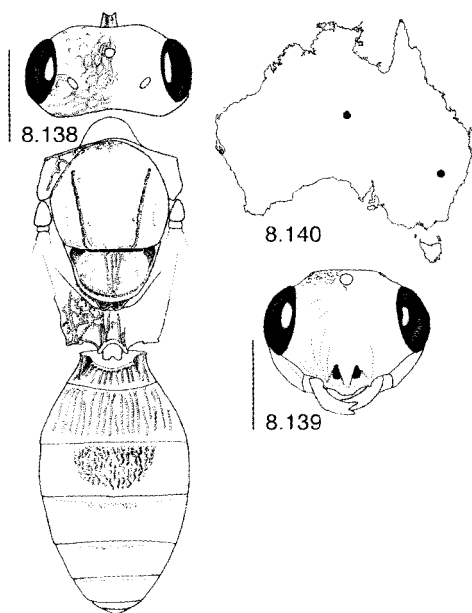
SCELIO MANNESI DANGERFIELD & AUSTIN SP. NOV.

(Figs 8.138–8.140)

Material examined

Holotype

♂, Northern Territory, '23.22S 133.48E 35 km NbyW Alice Springs, 27 May 1978, NT J.C. Cardale' (ANIC).



Figs 8.138–8.140. *Scelio mannesi* sp. nov.:
8.138. ♂ Holotype, dorsal habitus. **8.139.**
 ♂ Holotype, anterior head. **8.140.** Distribution
 map. Scale lines: 0.25 mm.

Paratype

New South Wales: 1 ♂, Gilgandra, 27 Oct. 1982, R.G. Pigott (ASCU); 1 ♂, Nyngan, 7 Jan. 1991, R. Pigott (ASCU).

Male

Length

2.6–3.0 mm (mean 2.8 mm).

Colour

Dark brown except trochanter, tibia, tarsi, apical antenna, mandibles and palps yellow to light brown.

Head

Width between eyes $0.63 \times$ width of head in dorsal view; OOL 0.06 mm; LOL 0.16–0.19 mm; POL 0.28–0.3 mm; ocellar diameter 0.06 mm, $0.14 \times$ width between eyes; head with fine, moderately sparse, moderately long pilosity; occiput rugulose; posterior vertex with irregular transverse carinae; medial vertex weakly punctate-reticulate with medial granulate patch; frons mostly smooth with very faint rugulosity; malar region mostly smooth with few, very faint radiating striae continuing onto ventral frons; malar space $0.5 \times$ as long as eye height; interantennal process short, narrow, smooth, with prominent lateral carinae continuing around antennal sockets; clypeus produced, evenly convex between lateral points; anteclypeus defined by broad smooth raised area; mandibles smooth, lower tooth $0.75 \times$ upper tooth, dorsal tooth absent; antennal segment 5 similar in width to 4 and 6, without clearly defined, tyloid.

Mesosoma

Pilosity very sparse, long, fine; dorsal pronotum rugulose; latero-dorsal pronotum sparsely rugulose-reticulate; latero-ventral pronotum striate-reticulate; pronotal shoulders prominent, defined by transverse carina; scutum mostly smooth and shiny, with small area of rugulosity

anteriorly; notauli well defined by deep narrow crenulate furrows; scutellum smooth with scattered punctation and medial band of strigosity, no lateral spines defined; dorsellum prominent, emarginate; mesopleuron obliquely strigose; mesosternum smooth and shiny; propodeum $0.44\text{--}0.47 \times$ as long as wide, rugulose about medial longitudinal carinae, with scattered pilosity laterally, postero-lateral area square; indentation about nucha very weak, broad and shallow.

Wings

Hyaline, with small fine transparent setae; stigmal spot defined as rounded translucent area, stigmal vein absent.

Metasoma

$1.75\text{--}1.9 \times$ as long as wide, with sparse moderately long fine pilosity; T1 $0.56\text{--}0.63 \times$ as long as upper anterior width, $0.35\text{--}0.36 \times$ as long as lower anterior width, longitudinally strigose; T2 longitudinally strigose; T3 smooth laterally, reticulate medially; T4–T6 mostly smooth with slight basal rugulosity; S1–S2 rugulose; S3–S5 smooth; S2 with shallow basal transverse ridge; S2–S3 without felt lines or nodes defined.

Female

Unknown.

Distribution

This species has been collected near Alice Springs, Northern Territory and central-eastern New South Wales (Fig. 8.140).

Host

Unknown.

Comments

Scelio mannesi is known from three male specimens which are similar to those of *S. chortoicetes* and *S. concinnus*. However, males of *S. chortoicetes* are far more heavily sculptured than the females, as are males for the majority of *Scelio* species. *Scelio mannesi* may eventually be synonymised with *S. concinnus* (known only from two females), but it is less heavily sculptured and differs in colour, characters which, for the present, justify the recognition of this species. It is named after Lachlan Stuart Mannes, a 'Fruit Doctor' from Mildura.

SCELIO MAREEBAENSIS DANGERFIELD & AUSTIN SP. NOV.

(Figs 8.141, 8.142)

Material examined

Holotype

♀, '15 km NE of Mareeba N. Qld 20.xi.1984–7.i.1985, Storey & Titmarsh' (ANIC).

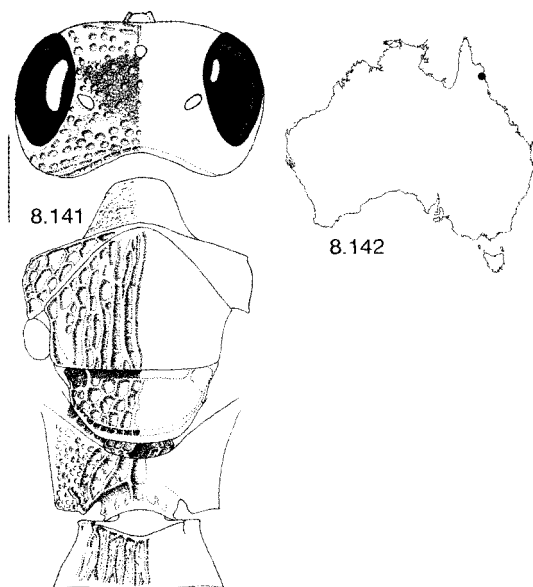
Paratypes

10 ♀, same data as holotype (ANIC).

Female

Length

4.0–4.5 mm (mean 4.3 mm).



Figs 8.141, 8.142. *Scelio mareebaensis* sp. nov.: **8.141.** ♀ Holotype, dorsal head to T1. **8.142.** Distribution map. Scale line: 0.25 mm.

Colour

Dark brown-black, except legs, scape and basal mandibles yellow-orange.

Head

Width between eyes $0.51\text{--}0.52 \times$ width of head in dorsal view; OOL $0.03\text{--}0.04$ mm; LOL $0.24\text{--}0.29$ mm; POL $0.35\text{--}0.35$ mm; ocellar diameter $0.07\text{--}0.08$ mm, $0.12\text{--}0.13 \times$ width between eyes; head with fine short sparse pilosity, denser and longer in occipital region; occiput with strigosity radiating from dorso-medial edge; posterior vertex punctate-reticulate, with transverse trend laterally on to temples; medial vertex and dorsal frons with moderately coarse punctation and fine pustulate background sculpturing; malar region with well defined radiating striae continuing halfway up frons, arching up and meeting above speculum; malar space $0.4\text{--}0.55 \times$ as long as eye height; inter-antennal process short, broad, narrowing ventrally, with lateral carinae continuing around anten-nal sockets, but not onto frons; clypeus produced between lateral points, convex medially; ante-clypeus narrowly defined by raised smooth area; mandibles smooth basally with medial striations, lower tooth $0.5\text{--}0.6 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, sparse, long, becoming coarser on lateral pronotum and dorsal scutellum; dorsal pronotum transversely strigose anteriorly, punctate to smooth posteriorly; latero-dorsal pronotum punctate-reticulate; latero-ventral pronotum rugose-reticulate with antero-dorsal smooth patch; pronotal shoulders prominent, defined by transverse carina; dorsal scutum with distinct coarse longitudinal strigosity, lateral scutum with coarse reticulate punctation; notauli poorly defined amongst sculpturing; scutellum coarsely punctate-reticulate, no lateral spines defined; dorsellum prominent, emarginate; mesopleuron rugose-reticulate anterior-ventrally to strigose dorso-posteriorly; mesosternum with dense moderately coarse punctures throughout; propodeum $0.4\text{--}0.45 \times$ as long as wide, rugose-reticulate about moderately deep medial longitudinal furrow, with short fine white pilosity laterally, postero-lateral area square to rounded; indentation about nucha deep.

Wings

Moderately infusate in apical two-thirds, with moderately short fine setae; stigmal spot defined, opaque light brown, with stigmal vein mostly absent to sometimes defined as faint infusate trace.

Metasoma

2.13–2.53 $\times$ as long as wide, with short stout pilosity laterally, becoming orange towards posterior metasoma; S6 with two rows of longer orange setae; T1 0.55–0.68 $\times$ as long as upper anterior width, 0.4–0.45 $\times$ as long as lower anterior width, longitudinally striate; T2 longitudinally strigate with background reticulation; T3–T5 longitudinally strigose, T3 with medial patch of reticulation; T6 punctate-reticulate; S1 longitudinally strigose with background reticulation; S2 with striate basal furrow and transverse ridge becoming strigate posteriorly; S3–S6 longitudinally rugulose with scattered regularly spaced foveolae; S2–S3 finely punctate felt, nodes defined.

Male

Unknown (see Comments).

Distribution

This species is known from Mareeba, north Queensland (Fig. 8.142).

Host

Unknown.

Comments

Scelio mareebaensis is the sister species of *S. zborowskii*. They are very similar to each other yet have no identifiable synapomorphies in common. They can be distinguished by colour and sculpturing of the vertex. This species has the unusual development of pustulate background sculpturing on the vertex (Fig. 8.141), which is also found in males of *Scelio* species-group O. However, males for this species are inferred from the phylogenetic analysis as lacking antennal tyloids, unlike males of species-group O, which have tyloids present. The species name is derived from the type locality, Mareeba.

SCELIO MATTHEWSI DANGERFIELD & AUSTIN SP. NOV.

(Figs 8.143, 8.144)

Material examined*Holotype*

♀, South Australia, 'Kangaroo Is., S. Aust., Flinders Chase Nat. Park, Gosse Wilderness Zone, 35.55S, 136.55E P.T.' 'beside creek Jan. 1986, A.D. Austin' (ANIC).

Paratypes

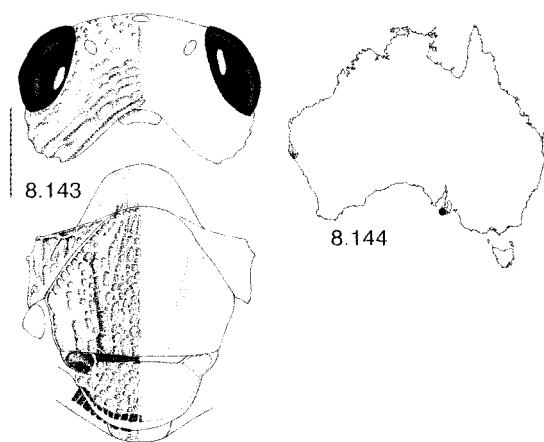
South Australia: 4 ♀, same data as holotype (1 ♀ SAMA, 1 ♀ WINC, 2 ♀ ANIC).

Female*Length*

4.2–4.7 mm (mean 4.5 mm).

Colour

Dark brown to black except scape, pedicel and legs orange to yellow; coxae sometimes slightly darker orange.



Figs 8.143, 8.144. *Scelio matthewsi* sp. nov.: 8.143. ♀ Holotype, dorsal head and mesosoma (excluding propodeum). 8.144. Distribution map. Scale line: 0.25 mm.

Head

Width between eyes $0.51\text{--}0.6 \times$ width of head in dorsal view; OOL $0.04\text{--}0.06$ mm; LOL $0.21\text{--}0.23$ mm; POL $0.34\text{--}0.39$ mm; ocellar diameter $0.06\text{--}0.07$ mm, $0.11\text{--}0.14 \times$ width between eyes; head with moderately short fine translucent pilosity; occiput with irregular striae; posterior vertex with irregular transverse striae; medial vertex mostly smooth with scattered moderately fine punctation; dorsal frons with medium-sized punctation; ventral frons with longitudinally striae about speculum; malar region with long well-defined radiating striae; malar space $0.47\text{--}0.56 \times$ as long as eye height; interantennal process narrowing slightly ventrally, with lateral carina continuing around antennal sockets, not onto frons; clypeus moderately produced between lateral points, with medial margin straight; anteclypeus defined by raised smooth marginal area; mandibles smooth and shiny, lower tooth $0.67\text{--}0.71 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, moderately long, translucent, becoming slightly coarser on dorso-lateral pronotum; dorsal pronotum faintly rugulose-reticulate; latero-dorsal pronotum punctate-reticulate to rugose-reticulate; latero-ventral pronotum smooth anteriorly, becoming striate with background reticulation posteriorly; pronotal shoulders moderately prominent, defined by shallow transverse carina; scutum punctate-reticulate; notauli defined as narrow crenulate furrows; scutellum punctate-reticulate, no lateral spines defined; dorsellum only slightly raised above lateral metanotum, appearing 'tucked under' scutellum, not emarginate; mesopleuron with transverse strigosity, sometimes punctate-reticulate medially; mesosternum irregularly punctate-reticulate; propodeum $0.43\text{--}0.51 \times$ as long as wide, rugose-reticulate about medial longitudinal furrow, with moderately dense long white pilosity laterally, postero-lateral area rounded; indentation about nucha present.

Wings

Lightly infusate with short fine brown setae; stigmal spot defined as elongate opaque light brown area, with long stigmal vein defined.

Metasoma

$2.43\text{--}2.70 \times$ as long as wide, with short fine pilosity laterally; T1 $0.7\text{--}0.8 \times$ as long as upper anterior width, $0.67\text{--}0.77 \times$ as long as lower anterior width; T1–T5 longitudinally striate to strigose; T6 punctate-reticulate; S1–S2 longitudinally strigose with background reticulation; S3–S5 longitudinally strigose laterally and narrow smooth area medially, with scattered

moderately fine punctation medially; S2 with shallow transverse basal ridge and low lateral felt nodes defined; S3 without felt lines or nodes; S6 with scattered moderately fine punctation.

Male

Unknown.

Distribution

Scelio matthewesi is known only from Kangaroo Island, South Australia (Fig. 8.144).

Host

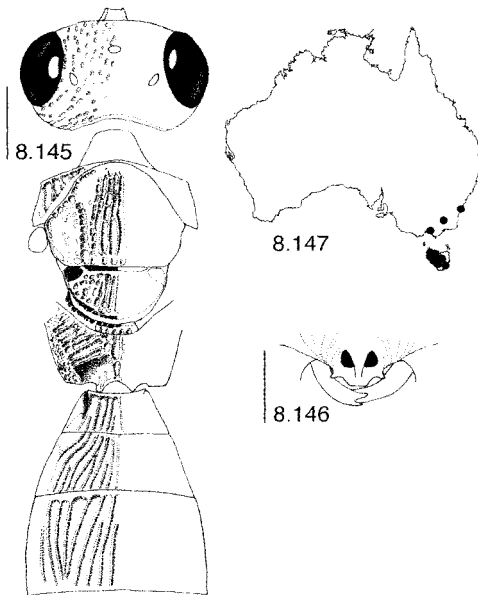
Unknown.

Comments

Scelio matthewesi is the sister species of *S. littoralis* + *S. asperatus* + *Sceliocerdo* + *S. nanocuspis* (Fig. 6.2, node 10) but can be distinguished from these by the interantennal carinae not continuing onto the speculum, and by having a low dorsellum. Males for this species are inferred from the phylogenetic analysis as having antennal tyloids. It is named after Nicholas John Matthews, former Honours student in Crop Protection at The University of Adelaide.

SCELIO MERIDIONALIS DANGERFIELD & AUSTIN SP. NOV.

(Figs 8.145–8.147)



Figs 8.145–8.147. *Scelio meridionalis* sp. nov.:
8.145. ♀ Holotype, dorsal head to T3.
8.146. ♀ Holotype, lower anterior head.
8.147. Distribution map. Scale lines: 0.25 mm.

Material examined

Holotype

♀, Tasmania, '41.58S, 145.28E Ewart Ck TAS 16 Jan.–2 Feb. 1983 I.D. Naumann & J.C. Cardale ex pantrap' (ANIC).

Paratypes

New South Wales: 1 ♀, Monga State forest, 19–24 Jan. 1984, L. Masner (CNCI). **Victoria:** 8 ♀, Belgrave, Dec. 1926, A.P. Dodd (ANIC). **Tasmania:** 7 ♀, same data as holotype (ANIC); 1 ♂, 4 km E Rosebery, 41.47S, 145.35E, 16 Jan.–1 Feb. 1983, I.D. Naumann, J.C. Cardale, M.T. (ANIC); 2 ♀, 14 km S Bronte Park, 42.15, 146.29E, 15 Jan.–3 Feb. 1983, I.D. Naumann, J.C. Cardale, M.T. (ANIC); 1 ♀, Collinsvale, 2 Feb. 1983, M.A. Williams, M.T. (ANIC); 1 ♀, 2 km NW Derwent Bridge, 24–28 Jan. 1980, A. Newton, M. Thayer, wet sclerophyll P.T. (ANIC); 1 ♂, 5 km EbyS Harford, 41.15S, 146.36E, 19 Jan. 1983, I.D. Naumann, J.C. Cardale (ANIC); 1 ♀, Kingston, 26 Dec. 1979, J.C. Cardale (ANIC); 1 ♂, The Lea, 42.56E, 147.16E, 5 Feb. 1983, I.D. Naumann, J.C. Cardale (ANIC); 1 ♀, Lyell Highway at Franklin River, 12–20 Feb. 1980, A. Newton, window trap (ANIC); 2 ♀, Hobart, Lea (ANIC); 1 ♀, Mt Field National Park, 8–14 Jan. 1984, L. Masner, M.T. (CNCI).

Other material examined

Victoria: 1 ♂, W side Cobungra Hill, 20 km WbyN Omeo, 27 Feb. 1980, I.D. Naumann, J.C. Cardale (ANIC); 1 ♀, Belgrave, Dec. 1926, A.P. Dodd (head missing) (ANIC). **Tasmania:** 1 ♀, Collinsvale, 2 Feb. 1983, M.A. Williams, MT (ANIC).

Female

Length

3.3–4.8 mm (mean 4.3 mm).

Colour

Dark brown except tibia, tarsi, basal femora, toruli, pedicel and medial mandibles yellow.

Head

Width between eyes $0.52\text{--}0.54 \times$ width of head in dorsal view; OOL $0.03\text{--}0.05$ mm; LOL 0.23 mm; POL 0.4 mm; ocellar diameter $0.06\text{--}0.07$ mm, $0.13 \times$ width between eyes; head with fine short sparse pilosity, denser in occipital region; occiput strigose; posterior vertex virtually smooth medially, punctate-reticulate with transverse trend laterally on to temples; medial vertex and dorsal frons with sparse fine punctation; malar region with well-defined radiating striae continuing halfway up frons; malar space $0.4\text{--}0.52 \times$ as long as eye height; interantennal process short, broad, with lateral carinae continuing around antennal sockets; clypeus produced between lateral points, convex to straight medially; anteclypeus broadly defined by raised smooth area; mandibles smooth, lower tooth $0.5\text{--}0.6 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, sparse, long; dorsal pronotum transversely strigose anteriorly, punctate posteriorly; latero-dorsal pronotum virtually smooth with faint rugulosity laterally; latero-ventral pronotum rugose-reticulate; pronotal shoulders prominent, defined by transverse carina; anterior scutum longitudinally strigose, posterior scutum longitudinally strigose to punctate-reticulate, lateral scutum virtually smooth medially with scattered punctation laterally; notauli defined, crenulate posteriorly, punctate anteriorly; scutellum strigose-punctate medially, punctate laterally, no lateral spines defined; dorsellum moderately prominent, not emarginate; mesopleuron rugose-reticulate anteriorly to punctate-reticulate posteriorly; mesosternum smooth medially, with scattered fine punctures laterally; propodeum $0.36\text{--}0.43 \times$ as long as wide, rugose-reticulate about moderately deep medial longitudinal furrow, with long fine pilosity laterally, postero-lateral area oblique with square corners; indentation about nucha shallow.

Wings

Lightly infusate, with short fine setae; stigmal spot defined, opaque light brown, stigmal vein short, poorly defined.

Metasoma

1.9–2.2 × as long as wide, with sparse fine pilosity lateral; T1 0.62–0.84 × as long as upper anterior width, 0.57–0.71 × as long as lower anterior width, longitudinally striate; T2 longitudinally strigose, becoming smoother medially; T3–T5 longitudinally strigose; T6 punctate; S1 longitudinally strigose; S2 with striate basal transverse ridge, becoming smooth and shiny posteriorly; S3–S6 smooth and shiny with scattered fine punctation; S2–S3 without felt lines or nodes defined.

Male

As for female, except generally more heavily sculptured especially in specimen from Omeo, Victoria, which has not been included as a paratype. Tyloid present on antennal segment 5.

Distribution

This species is known from Tasmania and the south-eastern corner of Australia (Fig. 8.147).

Host

Unknown.

Comments

Scelio meridionalis is resolved as the sister species of *S. nigrobrunneus*, although they do not share any unequivocal characters. They are the only species that show a reversal to a smooth mesosternum within the clade defined by having a sculptured mesosternum (Fig. 6.2, node 4). One female from Collinsvale, Tasmania (ANIC) has been excluded from the type series as it has unusual transverse striate sculpturing on the propodeum, but is the same as *S. meridionalis* in all other respects. Originally proposed by Ian Galloway, the species name is derived from the Latin ‘meridies’, meaning ‘south’, and refers to its southern distribution.

SCELIO MIKEI DANGERFIELD & AUSTIN SP. NOV.

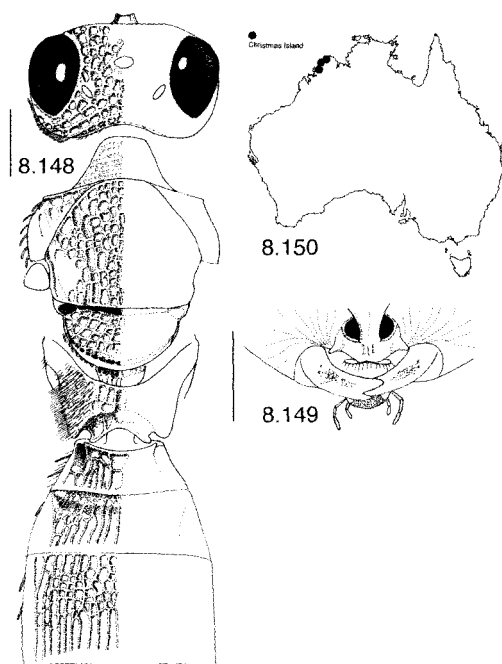
(Figs 8.148–8.150)

Material examined*Holotype*

♀, ‘CHRISTMAS ISLAND 10.30S 105.41E nr Greta Beach 19 April 1989 J.C. Cardale yellow trays’ (ANIC).

Paratypes

Western Australia: 4 ♀, CALM site 28/3, 4 km W of King Cascade, 15.38S, 125.15E, 12–16 Jun. 1988, T.A. Weir, M.T. with trough in closed forest (ANIC); 1 ♀, ‘The Crusher’ CALM site 9/1, 4 km SbyW Mining Camp Mitchell plateau, 2–6 Jun. 1988, I.D. Naumann, M.T. in closed forest (ANIC); 3 ♀, 2 ♂, CALM site 13/4, 12 km S of Kalumburu Mission, 7–11 Jun. 1988, T.A. Weir, M.T. with trough in closed forest. (ANIC). **Christmas Island:** 1 ♀, 2 ♂, same data as holotype; 4 ♀, 1 ♂, nr North West Point, 10.27S 105.33E, 13–28 Apr. 1989, J.F. Lawrence (ANIC); 3 ♀, 2 ♂, nr central area workshop, 10.29S 105.37E, 13–28 Apr. 1989, J.F. Lawrence (ANIC); 7 ♀, 5 ♂, nr Grants Well, 10.29S, 105.39E, 23–29 Apr. 1989, J.C. Cardale, yellow trays (ANIC); 1 ♀, nr The Blowholes, 24 Apr. 1989, J.C. Cardale, yellow trays (ANIC); 1 ♀, East-West Park Track, 10.30S, 105.35E, 13–28 Apr. 1989, J.C. Cardale



Figs 8.148–8.150. *Scelio miki* sp. nov.:
8.148. ♀ Holotype, dorsal head to T3.
8.149. ♀ Paratype, lower anterior head, showing sculptured mandibles and exposed labrum. **8.150.** Distribution map. Scale lines: 0.25 mm.

(ANIC); 1 ♀, 1 ♂, Hughs (No.2) Dale, 10.29S, 105.33E, 25 Apr. 1989, J.C. Cardale (ANIC); 1 ♀, 1 km N Margaret Knoll, 10.29S, 105.41E, 16 Apr. 1989, J.C. Cardale (ANIC); 2 ♀, nr South Point, 22 Apr. 1989, J.C. Cardale (ANIC); 4 ♀, 6 ♂, Ethel Beach, 10.28S, 105.42E, 13–28 Apr. 1989, J.C. Cardale (ANIC); 7 ♀, 6 ♂, Lily Beach Road, 10.28S, 105.42E, 13–28 Apr. 1989, J.C. Cardale (ANIC).

Female

Length

4.7–5.4 mm (mean 5.1 mm).

Colour

Brown except palps yellow. The Christmas Island specimens have the legs brown, whereas the specimens from mainland Western Australia have the legs bright yellow.

Head

Width between eyes 0.48–0.52 × width of head in dorsal view; OOL 0.04–0.06 mm; LOL 0.23 mm; POL 0.43 mm; ocellar diameter 0.11–0.13 mm, 0.19–0.2 × width between eyes; pilosity coarse especially on temples, white with yellow tinge on anterior vertex; occiput strigose; posterior vertex coarsely punctate-reticulate, becoming smaller medially; medial vertex moderately punctate-reticulate; dorsal frons coarsely punctate-reticulate; malar region with radiating striae continuing beyond interantennal process then grading to reticulate-punctate; malar space 0.42–0.48 × as long as eye height; interantennal process narrow with prominent lateral carinae; clypeus produced, convex to straight between lateral points; anteclypeus not well defined; mandibles smooth basally, with fine reticulation medially and striation sub-apically, lower tooth 0.7–0.9 × upper tooth, dorsal tooth absent.

Mesosoma

Pilosity mostly coarse, translucent, white, with orange tinge on medial scutum and scutellum, fine and long on dorsal pronotum; dorsal pronotum densely punctate; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum punctate anteriorly to rugose-reticulate posteriorly; pronotal shoulders defined by irregular rugosity; anterior and posterior scutum and scutellum rugose-reticulate, lateral scutum with broad smooth medial area; notauli roughly defined by slightly deeper rugosity; scutellum without lateral spines defined; dorsellum moderately prominent, not emarginate; mesopleuron punctate; mesosternum punctate-reticulate; propodeum $0.33\text{--}0.37 \times$ as long as wide, finely punctate laterally, with dense long white pilosity, coarsely punctate medially about medial longitudinal furrow, postero-lateral area rounded to obliquely truncate; indentation about nucha present.

Wings

Dark infuscation in apical two-thirds, with sub-medial transverse lighter stripe; stigmal spot dark, with long well-defined stigmal vein.

Metasoma

$2.4\text{--}2.8 \times$ as long as wide, with moderately coarse orange-tinged lateral pilosity; T1 $0.62\text{--}0.68 \times$ as long as upper anterior width, $0.5 \times$ as long as lower anterior width, with irregular longitudinal crenulations; T2 striate medially, becoming strigose laterally; T3 rugose-reticulate antero-medially, otherwise longitudinally strigose-reticulate; T4–T5 longitudinally striate; T6 rugose-reticulate; S1–5 longitudinally strigose; S3–S5 smooth medially; S2 with basal transverse ridge; S2–S3 with well-defined felt lines.

Male

As for female except femur more robust; antennal segment 5 broader than segments 4 and 6 with well-defined tyloid. In addition, male specimens from Western Australian are much smaller than females (length 3.3–3.4 mm).

Distribution

This species has been collected from the Kimberley region of Western Australia and Christmas Island (about 350 km south of Java in the Indian Ocean) (Fig. 8.150).

Host

Unknown.

Comments

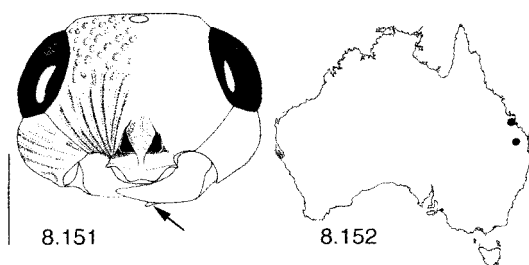
Scelio miki is the sister species of *S. setiger* + *S. pembedoni* + *S. varipunctatus* although they are not defined by any unequivocal characters. It is superficially similar to *S. bipartitus* but can be distinguished by the sculpturing of T3, the raised vertex, and the dense pilosity on the lateral propodeum. It is named after Michael Paul Heath Dangerfield.

SCELIO NANOCUSPIS DANGERFIELD & AUSTIN SP. NOV.

(Figs 8.151, 8.152)

Material examined*Holotype*

♀, Queensland, 'Chinchilla Q. Jany, 28 A. P. Dodd' (ANIC).



Figs 8.151, 8.152. *Scelio nanocuspis* sp. nov.: **8.151.** ♀ Paratype, anterior head, node-like lower tooth arrowed. **8.152.** Distribution map. Scale line: 0.25 mm.

Paratypes

Queensland: 26 ♀, same data as holotype with dates Jan. 1928, Feb. 1928, 3 Jan. 1929 and 1 Mar. 1930 (ANIC); 1 ♀, Gogango, 4 Jan. 1930, A.P. Dodd (ANIC).

Female

Length

4.3–4.9 mm (mean 4.55 mm).

Colour

Head and mesosoma dark brown to black, antennae, mandibles and metasoma orange to light brown; legs yellow.

Head

Width between eyes $0.53\text{--}0.56 \times$ width of head in dorsal view; OOL $0.04\text{--}0.06$ mm; LOL $0.27\text{--}0.33$ mm; POL $0.49\text{--}0.55$ mm; ocellar diameter $0.08\text{--}0.1$ mm, $0.13\text{--}0.14 \times$ width between eyes; head with fine moderately long translucent pilosity, becoming coarser and golden on frons and lower temples; occiput irregularly strigose; posterior vertex punctate-reticulate; medial vertex and dorsal frons with medium-sized punctation; ventral frons and malar region with radiating striae about speculum, becoming fainter dorsally; malar space $0.6\text{--}0.69 \times$ as long as eye height; interantennal process narrowed basally, with raised lateral carinae continuing onto ventral frons; clypeus well produced between lateral points, with medial margin straight; anteclypeus defined by raised smooth marginal area; mandibles smooth, lower tooth reduced to ventral node, $0.2\text{--}0.25 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, long, translucent, becoming coarser with orange tinge on scutum and scutellum; dorsal pronotum mostly smooth, with lateral faint irregular striae; latero-dorsal pronotum rugose-reticulate to punctate-reticulate; latero-ventral pronotum smooth anteriorly, strigose posteriorly; pronotal shoulders moderately prominent, defined by low transverse carina; scutum coarsely punctate-reticulate; notauli poorly defined by irregular furrow; scutellum punctate-reticulate, no lateral spines defined; dorsellum prominent, not or only slightly emarginate; mesopleuron transversely striate to strigose; mesosternum with scattered moderately coarse punctation; propodeum $0.33\text{--}0.35 \times$ as long as wide, rugose-reticulate laterally, without medial longitudinal furrow, with short sparse pilosity laterally, postero-lateral area square; indentation about nucha only very slight or absent.

Wings

Lightly infusate, with fine short light brown setae; stigmal spot defined as light brown translucent area, with long infusate stigmal vein.

Metasoma

1.93–2.0 × as long as wide, with fine moderately long lateral pilosity; T1 short and broad, 0.52–0.58 × as long as upper anterior width, 0.30–0.32 × as long as lower anterior width; T2–T4 with faint longitudinal strigosity medially, becoming reticulate laterally; T5 with moderately coarse well-defined longitudinal strigosity; T6 punctate-reticulate; S1 strigose with background reticulation; S2–S5 with coarse scattered punctation; S2 with basal furrow but no transverse ridge; S2–S3 without felt lines or nodes defined.

Male

Unknown.

Distribution

This species is known from only two localities in southern Queensland (Fig. 8.152).

Host

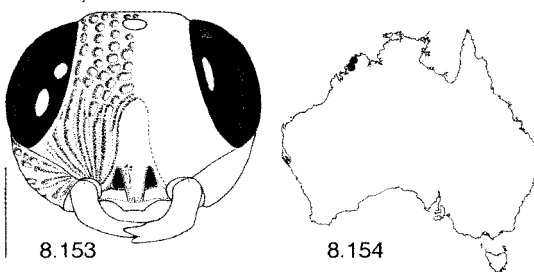
Unknown.

Comments

This species is similar to *S. nigrobrunneus* Dodd but can be distinguished by the reduced lower mandibular tooth. Its relationships are not clear, although in the phylogenetic analysis (Fig. 6.2) it is the sister taxon to *Sceliocerdo*. It is named after the Latin 'nano' meaning small and 'cuspis' meaning tooth.

SCELIO NAUMANNI DANGERFIELD & AUSTIN SP. NOV.

(Figs 8.153, 8.154)



Figs 8.153, 8.154. *Scelio naumanni* sp. nov.: **8.153.** ♀ Holotype, anterior head. **8.154.** Distribution map. Scale line: 0.25 mm.

Material examined*Holotype*

♀, Western Australia, '15.38S 125.15E CALM Site 28/3 4 km W of King Cascade W.A. 12–16 June 1988, T.A. Weir' 'Malaise trap with trough closed forest' (ANIC).

Paratype

Western Australia: 1 ♀, Mining Camp, Mitchell Plateau, 14.49S, 125.50E, 9–19 May 1983, I.D. Naumann, J.C. Cardale (ANIC).

Female*Length*

3.9–4.2 mm (mean 4.05 mm).

Colour

Head black, antennae, mandibles, pronotum, scutum, scutellum, metanotum and mesosternum brown, propodeum, legs, mesopleuron and metasoma yellow-orange.

Head

Width between eyes narrow $0.41\text{--}0.44 \times$ width of head in dorsal view; OOL 0.03 mm ; LOL $0.22\text{--}0.23\text{ mm}$; POL $0.29\text{--}0.3\text{ mm}$; ocellar diameter 0.1 mm , $0.2\text{--}0.23 \times$ width between eyes; head with short fine translucent pilosity, becoming slightly longer and coarser on dorsal frons; occiput smooth with faint fine punctation from associated pilosity; vertex and dorsal frons coarsely punctate-reticulate; malar region with coarse well-defined radiating striae which arch over and meet above speculum; malar space short $0.37\text{--}0.4 \times$ as long as eye height; interantennal process with well-developed lateral carinae continuing around antennal sockets, not onto frons; clypeus well produced between lateral points with medial margin slightly concave; anteclypeus defined by smooth marginal area continuing onto lateral points; mandibles smooth and shiny, lower tooth $0.44\text{--}0.57 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, long, translucent, becoming slightly coarser with yellow tinge on lateral pronotum, scutum and scutellum; dorsal pronotum irregularly punctate; latero-dorsal pronotum coarsely punctate-reticulate; latero-ventral pronotum smooth anteriorly to punctate medially, striate posteriorly; pronotal shoulders moderately prominent, defined by transverse carina; scutum punctate-reticulate to rugose-reticulate; notauli poorly defined by trend of deeper punctation; scutellum punctate-reticulate to rugose-reticulate medially, no lateral spines defined; dorsellum prominent, broad, emarginate; mesopleuron punctate-reticulate laterally with smooth medial patch; mesosternum smooth with moderately coarse scattered punctation; propodeum short and broad $0.38\text{--}0.4 \times$ as long as wide, rugulose laterally, with coarse longitudinal striae antero-medially and very fine sparse pilosity laterally, postero-lateral area square; indentation about nucha present.

Wings

Lightly infusate, with fine short setae; stigmal spot well defined, round and opaque buff to brown coloured, with long well-defined infusate stigmal vein.

Metasoma

$1.90\text{--}1.95 \times$ as long as wide, with fine sparse pilosity laterally; T1 $0.45 \times$ as long as upper anterior width, $0.33\text{--}0.34 \times$ as long as lower anterior width; T1–T5 moderately coarse longitudinally striate to strigose; T6 rugose-reticulate; S1–S5 longitudinally strigose with scattered foveolae, S2 with basal transverse furrow but without associated ridge; S2–S3 with raised finely pilose felt nodes defined.

Male

Unknown.

Distribution

Scelio naumanni is known from the Kimberley region of Western Australia (Fig. 8.154).

Host

Unknown.

Comments

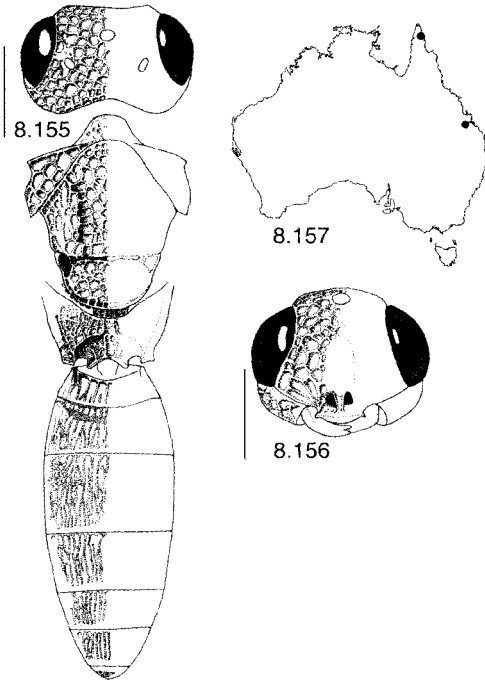
Scelio naumanni is the sister species of *S. sulcaticeps* and, although they have no unequivocal character states, they can be distinguished by a transverse pronotal carina and poorly defined

notauli. Males for this species are inferred from the phylogenetic analysis as lacking antennal tyloids. It is named in honour of Ian Naumann, Australian National Insect Collection, Canberra, for his help with this project over the last 10 years.

***SCELIO NIGRICORNIS* DODD**

(Figs 8.155–8.157)

Scelio nigricornis Dodd, 1913a: 136.- Kieffer, 1926: 343; Dodd, 1927: 151; Galloway 1976: 105; Galloway & Austin, 1984: 10; Johnson, 1992: 483.



Figs 8.155–8.157. *Scelio nigricornis* Dodd: 8.155. ♂ Holotype, dorsal habitus. 8.156. ♂ Holotype, anterior head. 8.157. Distribution map. Scale lines: 0.25 mm.

Material examined

Holotype

♂, Queensland, no data label on pinned specimen, microscope slide ‘sweeping in forest Nelson NQ 29.xi.1912 A.P. Dodd’ (see Comments) (SAMA).

Other material examined

Queensland: 1 ♂, Moura, Brigalow Development area, 19 Jan. 1966, P.D. Rossiter (QDPC); 1 ♂, Westwood, Nov. 1927, A.P. Dodd (ANIC).

Male

Length

2.7–3.0 mm (mean 2.9 mm).

Colour

Dark brown, except coxae, antennae and mandibles light brown, trochanter to tarsus yellow.

Head

Width between eyes $0.52\text{--}0.57 \times$ width of head in dorsal view; OOL $0.05\text{--}0.06$ mm; LOL $0.16\text{--}0.17$ mm; POL $0.26\text{--}0.29$ mm; ocellar diameter $0.08\text{--}0.09$ mm, $0.18\text{--}0.19 \times$ width between eyes; head with fine sparse short translucent pilosity; occiput rugulose; vertex rugose-reticulate; frons rugose-reticulate; malar region rugose-reticulate; malar space $0.4\text{--}0.41 \times$ as long as eye height; interantennal process narrowed ventrally, with lateral carinae continuing around antennal sockets; clypeus moderately produced and convex between lateral points; anteclypeus defined by raised smooth marginal area; mandibles smooth, lower tooth $0.67\text{--}0.78 \times$ upper tooth, dorsal tooth absent; antennal segment 5 slightly wider than 4 and 6, longitudinal tyloid present with pronounced apical point.

Mesosoma

Pilosity fine, sparse, translucent; dorsal pronotum punctate to rugulose; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum smooth anteriorly, becoming rugose-reticulate posteriorly; pronotal shoulders prominent, defined by transverse carina; scutum with irregular coarse punctate-reticulation; notauli moderately well defined as crenulate furrows; scutellum punctate-reticulate, no lateral spines defined; dorsellum moderately prominent, not emarginate; mesopleuron moderately finely punctate; mesosternum punctate; propodeum $0.43\text{--}0.45 \times$ as long as wide, rugose-reticulate, medial longitudinal furrow absent, with very sparse fine pilosity laterally, postero-lateral area narrowing and square; indentation about nucha present.

Wings

Hyaline, with very short fine translucent setae; stigmal spot and stigmal vein absent.

Metasoma

$2.16\text{--}2.48 \times$ as long as wide, with faint sparse short pilosity laterally; T1 $0.5 \times$ as long as upper anterior width, $0.36\text{--}0.42 \times$ as long as lower anterior width, longitudinally striate to strigose; T2 longitudinally striate; T3–T5 strigose-reticulate, becoming fainter medially; T6 longitudinally striate; S1–S2 rugulose-reticulate; S3–S6 with moderately fine sparse punctuation medially, rugulose-reticulate laterally; S2 with basal transverse ridge; S2–S3 without felt lines or nodes defined.

Female

Unknown.

Distribution

This species has been collected from north and south-east Queensland (Fig. 8.157).

Host

Unknown.

Comments

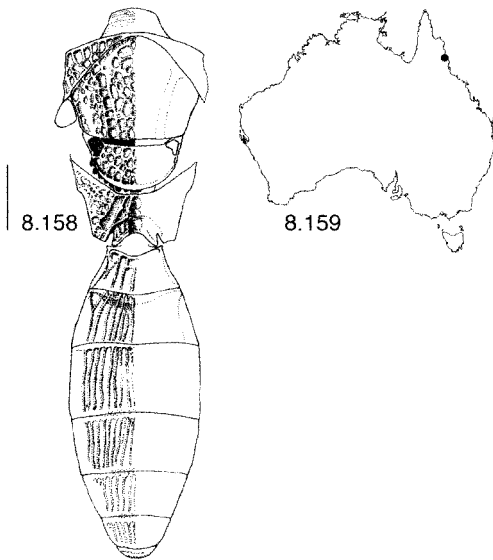
Scelio semisanguineus, described from a female specimen, was treated by Dodd (1927) as a junior synonym of *S. nigricornis*, the holotype of which is a male. However, there is no evidence to support this association and, even though *Scelio* species can be highly sexually dimorphic, the holotypes of the above taxa are substantially different. They should be treated as separate species until the sexes of these and related species can be positively associated from reared material. The holotype *S. nigricornis* has one complete antenna and the other with only six segments. A slide which is labelled 'type' has one complete antenna and 2 antennal segments of another, so these must be from another specimen (i.e. not the holotype).

Like the males of numerous other Australian *Scelio*, this species is not easily distinguishable; however, the following characters will help with its identification: basal manible smooth, tyloid present and elongate, frons gently convex and without ridges, dorsellum only slightly raised, sculpturing as in Figs 8.155 and 8.156, and T1 broad.

***SCELIO NIGRICOXA* DODD STAT. REV.**

(Figs 8.158, 8.159)

Scelio nigricoxa Dodd, 1914a: 78.- Dodd, 1914b: 111; Kieffer, 1926: 313; Galloway, 1976: 105; Johnson, 1992: 487. Synonymised with *S. punctaticeps* by Dodd 1927:171.



Figs 8.158, 8.159. *Scelio nigricoxa* Dodd: 8.158. ♂ Holotype, dorsal mesosoma and metasoma. 8.159. Distribution map. Scale line: 0.25 mm.

Material examined

Holotype

♂, no data label (SAMA). North Queensland, Nelson, near Cairns (Dodd, 1914a). Specimen pointed with head missing and wings detached. Antennae mounted on one slide and fore wings on another.

Male

Length

3.5 mm (without head).

Colour

Dark brown except legs; coxae light brown, femora to tarsi yellow.

Head

Missing; antennae (slide mounted) with elongate tyloid on antennal segment 5.

Mesosoma

Pilosity fine, sparse, long, translucent; dorsal pronotum with irregular transverse striae; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum smooth anterodorsally, otherwise rugulose-reticulate; pronotal shoulders prominent, defined by transverse carina; scutum with moderately coarse reticulate punctation; notauli moderately well defined; scutellum with coarse punctation, no lateral spines defined; dorsellum moderately prominent, not emarginate; mesopleuron punctate; propodeum $0.45 \times$ as long as wide, punctate-reticulate to rugose-reticulate about medial longitudinal furrow, with fine short translucent pilosity laterally, postero-lateral area oblique-square; indentation about nucha present.

Wings

Slide mounted with basal one-fifth missing. Lightly infusate, becoming darker in apical two-thirds, with short fine setae; lightly infusate stigmal spot defined, with infusate stigmal vein.

Metasoma

$2.4 \times$ as long as wide, with sparse fine short translucent pilosity laterally; T1 $0.8 \times$ as long as upper anterior width, $0.75 \times$ as long as lower anterior width, longitudinally strigose; T2–T6 longitudinally strigose, with small medial smooth area; S1–S2 longitudinally strigose, with medial longitudinal carina that is more prominent in S1; S3–S5 with fine punctation medially, becoming punctate-reticulate laterally; S2 with shallow basal transverse ridge and carina; S2 with felt nodes defined, S3 without felt nodes.

Female

Unknown.

Distribution

Only known from the holotype specimen from Nelson, Queensland (Fig. 8.159).

Host

Unknown.

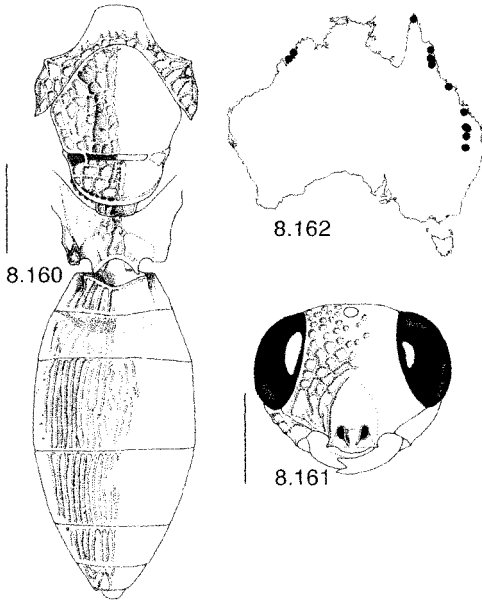
Comments

Dodd (1914a) indicated that *S. nigricoxa* differed from *S. punctaticeps* by having the coxae and antennae black, the stigmal vein straight and the third funicle joint dilated. Wing venation characters in the holotype slide mounts have cleared over time and are no longer visible.

The synonymy of *S. nigricoxa* with *S. punctaticeps* by Dodd (1927) is questioned here due to the character differences outlined above, the presence of notauli on *S. nigricoxa*, and that the type of *S. nigricoxa* is a male. It could just as easily be assigned as the male of *S. striatifacies* based on the defined notauli and brown coxae. The holotype of *S. nigricoxa* has the head missing so its sculpturing pattern remains uncertain and, as it is a male, the metasomal dimensions cannot be compared to the female holotypes as in all other associated species. The holotype is similar to some males of species-group 'W' but the absence of the head prevents these specimens being associated. The original description of *S. striatifacies* stated that it is very similar to *S. nigricoxa* but more stout, especially in the metasoma. The male of *S. nigricoxa* cannot clearly be associated with the females of these two species based on morphology alone and is therefore taken out of synonymy.

SCELIO NIGRISCUTELLUM DODD

(Figs 8.160–8.162)

Scelio nigriscutellum Dodd, 1913a: 137.- Dodd, 1914b: 110; Kieffer, 1926: 337; Dodd, 1927: 148; Galloway, 1976: 105; Galloway & Austin, 1984: 11; Johnson, 1992: 483.*Scelio melanogaster* Dodd, 1920: 347.- Masner, 1965: 94; Galloway, 1976: 105.*Scelio nigriscutellum pretiosus* Dodd, 1927: 149.- Galloway, 1976: 105; Galloway & Austin, 1984: 11. **Syn. nov.**

Figs 8.160–8.162. *Scelio nigriscutellum* Dodd: **8.160.** ♀ Holotype, dorsal mesosoma and metasoma. **8.161.** ♀ Holotype, anterior head. **8.162.** Distribution map. Scale lines: 0.25 mm.

Material examined*Holotypes*

♀ (*S. nigriscutellum*), no collection data label, Dodd (1927) stated North Queensland as the only known collection data (head missing) (SAMA); ♀ (*S. melanogaster*), 'Mackay 5.97' '993' (BMNH); ♀ (*S. nigriscutellum pretiosus*), 'Chinchilla Qld. Jan. 26 A.R. Taylor' (ANIC).

Other material examined

Queensland: 2 ♀, Boggom via Taroom, 25.29S, 150.08E, Nov. 1996, Jan. 1997, Cook, Monteith, F.I.T., P.T. (QMBA); 4 ♀, Chinchilla, Nov. 1926, A.P. Dodd (ANIC); 2 ♀, Gogango, Feb. 1930, Oct. 1932, A.P. Dodd (ANIC); 2 ♀, Goondiwindi, Jan. 1928, 7 Dec. 1932, A.P. Dodd (ANIC); 3 ♀, Heathlands, 11.45S, 142.35E, 18 Sep.–21 Oct. 1992, 5 Apr.–18 Jun. 1993, P. Zborowski, T. Weir, A. Roach, I. Naumann (ANIC); 1 ♀, Julatten, Black Mountain Road, 15 Oct.–21 Nov. 1987, A. Walford-Huggins (ANIC); 1 ♀, Mareeba, 17–21 Jun. 1992, D.H. Habeck, M.T. (CNCI); 1 ♀, Mt Abbott, 20.06S, 147.45E, 7 Dec. 1996–9 Apr. 1997, Monteith, Cook (QMBA); 1 ♀, 7.1 km on road to Granite Gorge near Mt Aunt, Atherton Tblel., 4 May 1988, E.C. Dahms, G. Sarnes (QMBA); 1 ♀, Mt Cook Nat. Pk., 15.29S, 145.16E, 10–12 May 1981, I.D. Naumann (ANIC). **New South Wales:** 3 ♀, Wincalda, 30 Oct. 1927, A.P. Dodd (ANIC). **Western Australia:** 1 ♀, Augustus Island, CALM Site 26/1, 15.25S, 124.38E, 11–16 Jun. 1988, I.D. Naumann (ANIC); 1 ♀, 'The Crusher', Mining camp Mitchell Plateau, 14.52S, 125.50E, 2–6 Jun. 1988, I.D. Naumann, M.T. (ANIC).

Female

Length

2.6–3.6 mm (mean 3.2 mm).

Colour

Orange, except head black, antennae light to mid brown, scutellum and metasoma orange to light brown.

Head

Width between eyes $0.5\text{--}0.51 \times$ width of head in dorsal view; OOL $0.03\text{--}0.05$ mm; LOL $0.15\text{--}0.21$ mm; POL $0.28\text{--}0.35$ mm; ocellar diameter $0.06\text{--}0.08$ mm, $0.14\text{--}0.17 \times$ width between eyes; head with short fine translucent pilosity; occiput faintly rugulose; posterior vertex rugose-reticulate to punctate-reticulate; medial vertex punctate to punctate-reticulate; dorsal frons punctate; ventral frons punctate-reticulate to striate-reticulate; malar region with radiating striae which become increasingly reticulate dorsally; malar space $0.37\text{--}0.48 \times$ as long as eye height; interantennal process short and broad, with transverse carina medially, lateral carinae continuing around antennal sockets; clypeus produced, evenly convex between lateral points; anteclypeus defined by raised smooth marginal area; mandibles smooth, lower tooth $0.8\text{--}1.0 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, sparse, translucent; dorsal pronotum mostly smooth; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum smooth anteriorly, becoming rugulose-reticulate posteriorly; pronotal shoulders with acute lateral point but not defined by transverse carina; scutum rugose-reticulate; notauli defined by crenulate furrows; scutellum rugose-reticulate, no lateral spines defined; dorsellum prominent, emarginate with upwardly directed lateral points; mesopleuron finely rugulose-reticulate to punctate-reticulate with oblique trend; mesosternum punctate-reticulate to smooth medially; propodeum $0.47\text{--}0.52 \times$ as long as wide, with very faint rugulose-reticulation laterally, becoming stronger medially, medial longitudinal furrow present, with very sparse pilosity laterally, postero-lateral area produced, square and narrow; indentation about nucha present.

Wings

Lightly infusate, with short fine setae; moderately dark infusate stigmal spot defined, with lightly infusate stigmal vein.

Metasoma

$1.94\text{--}2.1 \times$ as long as wide, with very sparse short fine translucent pilosity; T1 $0.37\text{--}0.44 \times$ as long as upper anterior width, $0.32\text{--}0.39 \times$ as long as lower anterior width, longitudinally strigose; T2 faintly longitudinally striate; T3 striate to strigose laterally, becoming lightly reticulate medially; T4–T5 longitudinally striate; T6 rugulose; S1–S5 longitudinally strigose, S4–S5 becoming smooth medially; S2 with basal transverse ridge; S2–S3 without felt lines or nodes defined.

Male

Unknown.

Distribution

This species is found in the Kimberley region of Western Australia, and along the east coast from Cape York to south-east Queensland (Fig. 8.162).

Host

Unknown.

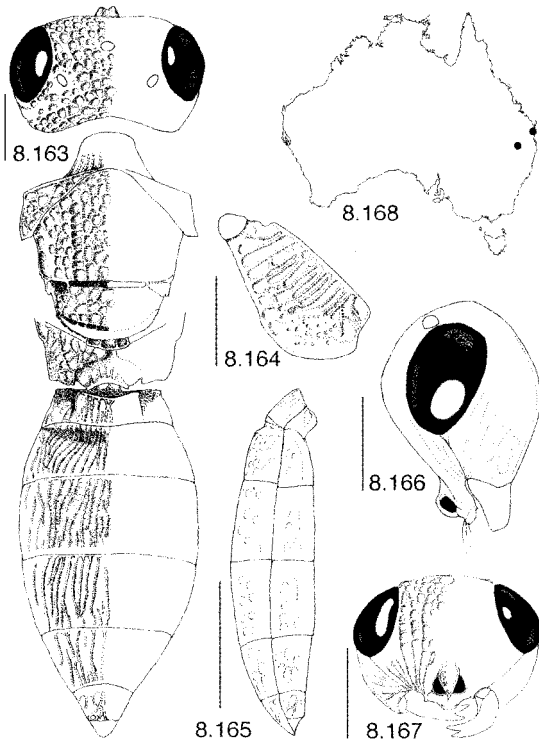
Comments

Scelio nigriscutellum pretiosus Dodd is here synonymised with *S. nigriscutellum*. Dodd (1927) suggested that, when more material was found, the variety described as *S. n. pretiosus*, later treated as a subspecies by Galloway (1976), would not hold up. This has been the case, even though little extra material has become available. In the phylogenetic analysis *S. nigriscutellum* is the sister species of *S. improcerus* and, although they share no unequivocal character states, they can be distinguished by the colour of the scutum and coxae, the form of the occipital carina and the mesopleuron sculpturing. This species is superficially similar to *S. bronae* and *S. fulvithorax*, but can be distinguished from *S. bronae* by the emarginate dorsellum and faint propodeal sculpturing, and from *S. fulvithorax* by the lack of a pronotal transverse carina, the absence of transverse sculpturing on the posterior vertex, and the faintly sculptured lateral propodeum.

SCELIO NIGROBRUNNEUS DODD

(Figs 8.163–8.168)

Scelio nigrobrunneus Dodd, 1927: 156.- Galloway, 1976: 106; Galloway & Austin, 1984: 11; Johnson, 1992: 483.



Figs 8.163–8.168. *Scelio nigrobrunneus* Dodd:

- 8.163. ♀ Paratype, dorsal habitus.
- 8.164. ♀ Holotype, mesopleuron.
- 8.165. ♀ Holotype, lateral metasoma.
- 8.166. ♀ Holotype, lateral head.
- 8.167. ♀ Holotype, anterior head.
- 8.168. Distribution map. Scale lines: 0.25 mm.

Material examined

Holotype

♀, New South Wales, 'Moree, N.S.W. March, 1926, A.P. Dodd' (metasoma detached from rest of body on separate point) (SAMA).

Paratypes

New South Wales: 2 ♀, same data as holotype (ANIC, QMBA).

Other material examined

Queensland: 1 ♀, Mt Glorious NP. Feb. 1989, H. Howden (CNCI). **New South Wales:** 2 ♀, same data as holotype, with date Jan. 1926 (ANIC).

Female

Length

4.3–4.6 mm (mean 4.45 mm).

Colour

Dark brown except legs yellow, metasoma and antennae brown.

Head

Width between eyes $0.53\text{--}0.56 \times$ width of head in dorsal view; OOL 0.06 mm; LOL 0.25–0.28 mm; POL 0.43–0.48 mm; ocellar diameter 0.09–0.11 mm, $0.14\text{--}0.16 \times$ width between eyes; head with moderately long fine translucent pilosity, becoming slightly coarser on frons; occiput rugulose; posterior vertex rugose-reticulate to punctate-reticulate; medial vertex and dorsal frons punctate-reticulate; ventral frons punctate-reticulate laterally, with smooth area medially; malar region with ventral radiating carinae continuing dorsally and becoming reticulate dorsally; malar space $0.53\text{--}0.68 \times$ as long as eye height; interantennal process strongly narrowed ventrally, with lateral carinae continuing onto frons dorsally; clypeus well produced, convex between lateral points; anteclypeus defined by smooth narrow raised marginal area; mandibles smooth, with lower tooth $0.56\text{--}0.67 \times$ upper, with dorsal tooth absent.

Mesosoma

Pilosity moderately long, fine, translucent; dorsal pronotum smooth anteriorly, longitudinally strigose posteriorly; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum rugose, with longitudinal furrow posteriorly; pronotal shoulders prominent, defined by transverse carina; scutum punctate-reticulate; notauli defined by crenulate furrow; scutellum rugose-reticulate to punctate-reticulate, no lateral spines defined; dorsellum moderately prominent, not emarginate; mesopleuron obliquely strigose; mesosternum smooth with scattered punctuation; propodeum short $0.31\text{--}0.36 \times$ as long as wide, rugulose laterally, short medial longitudinal furrow present, with short fine pilosity, postero-lateral area oblique to square; indentation about nucha shallow.

Wings

Lightly infusate, with short fine setae; stigmal spot defined, with long stigmal vein.

Metasoma

$2.02\text{--}2.14 \times$ as long as wide, with moderately long fine pilosity; T1 $0.46\text{--}0.48 \times$ as long as upper anterior width, $0.25\text{--}0.3 \times$ as long as lower anterior width, T1–T6 longitudinally strigose, with fine background reticulation; S1 longitudinally strigose; S2–S5 with moderately coarse scattered punctures, S4–S5 smoother medially, S2 with weakly defined basal transverse furrow; S2–S3 without felt lines or nodes defined.

Male

Unknown.

Distribution

Scelio nigrobrunneus is only known from Moree, northern New South Wales, and Mt Glorious, southern Queensland (Fig. 8.168).

Host

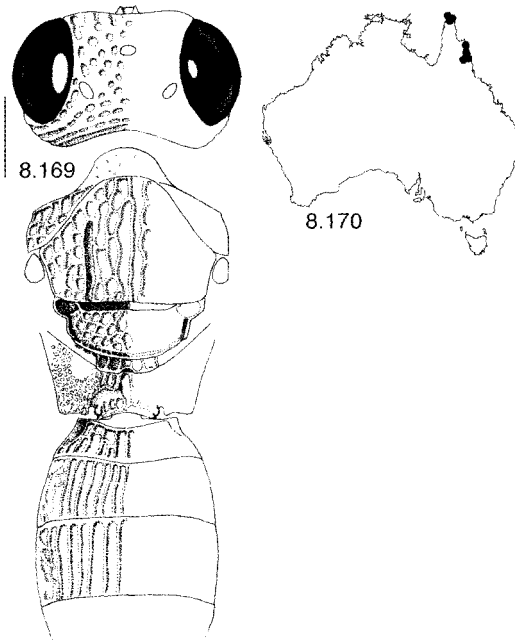
Unknown.

Comments

Scelio nigrobrunneus is consistently resolved as the sister species of *S. meridionalis* and, although they do not share any unequivocal characters, they are the only group which has a reversal of the mesosternal sculpturing at node 4 (Fig. 6.2). This species is distinctive because of the form of the propodeal indentation about the nucha, the narrow upper versus broad lower widths of anterior T1, the small eyes, and the short smooth propodeum. It has only been collected once, in 1989, since its original description in 1927.

SCELIO NOTABILIS DODD

(Figs 8.169, 8.170)



Figs 8.169, 8.170. *Scelio notabilis* Dodd: **8.169.** ♀ Holotype, dorsal head to T3. **8.170.** Distribution map. Scale line: 0.25 mm.

Scelio notabilis Dodd, 1927: 158.- Galloway, 1976: 106; Galloway & Austin, 1984: 11; Johnson, 1992: 484.

Material examined

Holotype

♀, Queensland, 'Gordonvale, N.Q., May 1920' (SAMA).

Paratypes

Queensland: 5 ♀, same data as holotype (1, SAMA; 3, ANIC; 1, QMBA).

Other material examined

Queensland: 1 ♀, same data as holotype (ANIC); 2 ♀, Cockatoo Creek Crossing, 17 km NW Heathlands, 11.39S, 142.27E, 22 Mar.–25 Apr. 1992, T. McLeod, P. Feehney, M.T. (ANIC); 4 ♀, Cow Bay, N of Daintree R., 22 Feb.–29 Mar. 1983, Storey, Cunningham, M.T. (1, WINC; 3, ASCU); 1 ♀, Heathlands, 11.45S, 142.35E, 18 Aug.–17 Sep. 1992, P. Zborowski and L. Miller, M.T. (ANIC); 1 ♀, 14 km WbyN Hope Vale Mission, 7–10 May 1981, I.D. Naumann (ANIC); 1 ♀, Dividing Range, 15 km W Capt. Billy Creek, Cape York Pen., 11.40S, 142.45E, 4–9 Jul. 1975, S.R. Monteith (ASCU); 1 ♀, Davis Creek N.P., 10 km E Mareeba, 17–24 Feb. 1984, L. Masner, M.T. (CNCI); 4 ♀, 16 km up Davies Creek Rd via Mareeba, 4–13 Mar. 1983 and 18 Jan.–2 Feb. 1983, Storey, Titmarsh (ASCU); 2 ♀, Kuranda, Dec. 1930, A.P. Dodd (ANIC); 3 ♀, Rex Range Lookout via Julatten, 9 Nov.–2 Dec. 1981, M.T. (1, WINC; 2, ASCU).

Female

Length

3.6–4.0 mm (mean 3.8 mm).

Colour

Brown except legs, mandibles and antennal segments 1–4 yellow. Antennae with distinct contrast between yellow base and black apex.

Head

Width between eyes $0.43\text{--}0.47 \times$ width of head in dorsal view; OOL $0.03\text{--}0.05$ mm; LOL $0.19\text{--}0.21$ mm; POL $0.29\text{--}0.34$ mm; ocellar diameter $0.09\text{--}0.12$ mm, $0.18\text{--}0.25 \times$ width between eyes; head with fine short moderately sparse pilosity; posterior vertex with transverse coarse carinae or punctation in transverse lines about occiput; medial vertex and dorsal frons with moderately coarse non-confluent punctation; malar region with coarse radiating striae continuing onto ventral frons; malar space $0.33\text{--}0.38 \times$ as long as eye height; interantennal process with lateral carinae, continuing around antennal sockets, not onto frons; clypeus moderately produced between lateral points, with medial margin straight; anteclypeus defined by raised smooth marginal area; mandibles smooth, lower tooth $0.53\text{--}0.79 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, moderately long; dorsal pronotum smooth, with fine punctation associated with pilosity; latero-dorsal pronotum punctate-reticulate; latero-ventral pronotum smooth anteriorly, becoming rugose-reticulate posteriorly; pronotal shoulders prominent, defined by transverse carina; scutum coarsely punctate-reticulate, with distinct longitudinal trend medially; notauli defined as smooth furrow amongst sculpturing; scutellum coarsely punctate-reticulate to rugose-reticulate, no lateral spines defined, but with raised lobe posterior to axilla; dorsellum prominent, broad, very slightly to moderately emarginate; mesopleuron coarsely rugose at edges, with medial smooth patch; mesosternum punctate-reticulate to foveolate; propodeum short, $0.31\text{--}0.45 \times$ as long as wide, rugose-reticulate medially, moderately finely punctate-reticulate laterally, with anterior smooth patches, medial longitudinal furrow poorly defined, postero-lateral area square; indentation about nucha deep and narrow, with small protruding lobes on inner side of indentation.

Wings

Lightly infusate, with short fine golden setae; stigmal spot defined as opaque light-coloured area, with spectral stigmal vein.

Metasoma

2.06–2.2 × as long as wide, with fine sparse pilosity laterally; T1 0.34–0.42 × as long as upper anterior width, 0.27–0.31 × as long as lower anterior width, rugose-reticulate; T2–T5 with coarse longitudinal striations, rugose laterally; T6 rugose-reticulate; S1–S5 longitudinally strigose, S2 with basal transverse furrow and ridge; S2–S3 with felt nodes poorly defined.

Male

Unknown; possibly members of species-group 'R' based on morphology and collecting data.

Distribution

This species is only known from north Queensland (Fig. 8.170).

Host

Unknown.

Comments

This is the sister species of *S. mareebaensis* + *S. zborowskii* and, although they are not defined by any unequivocal synapomorphies, they share the longitudinal trend to the sculpturing on the scutum. Males for this species are inferred from the phylogenetic analysis as lacking antennal tyloids. See comments under *Scelio* species-group R (below).

SCELIO ORIENTALIS DODD

(Figs 8.171–8.173)

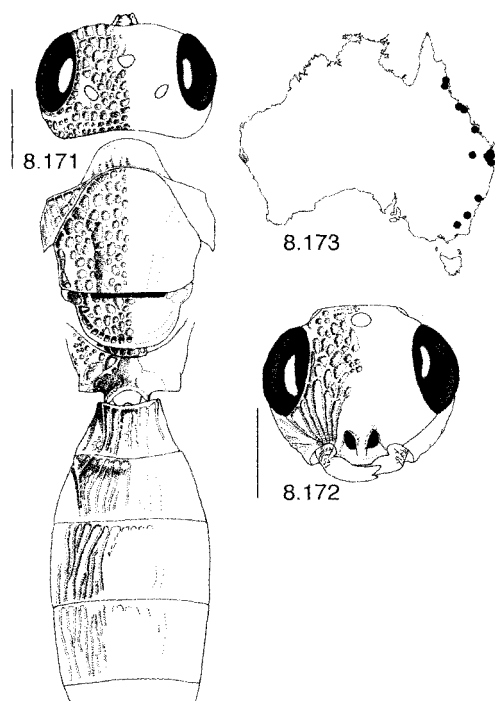
Scelio orientalis Dodd, 1914c: 29.–Dodd, 1914b: 112 (published simultaneously with 1914c); Keiffer, 1926: 343; Dodd, 1927: 161; Galloway, 1976: 106; Galloway & Austin, 1984: 11; Johnson, 1992: 485.

Material examined*Holotype*

♂, no data label, from description 'Queensland: Cairns district, in February, A.P. Dodd', antennae and fore wings on slide with appendages of ♂ *S. australis* (SAMA).

Other material examined

Queensland: 29♀, 22♂, Brisbane, Indooroopilly site, Feb. 1978 and 8–14 Mar. 1983, M.T. (ASCU); 1♂, Brisbane, May 1977, K.J. Houston, M.T. (ASCU); 1♂, Davis Creek N.P., 10 km E Mareeba, L. Masner (CNCI); 4♀, 1♂, Buderim, 14–22 Mar. 1985, G.K. Waite, M.T. (ASCU); 1♀, 2♂, Camp Mountain (Marks), 7–14 Jan. 1980, M.T., open sclerophyll gully (ASCU); 2♂, 16 km up Davies Creek Road via Mareeba, 18 Feb.–3 Mar. 1983, Storey, Titmarsh (WINC); 3♂, Expedition Range NP, 'Amphitheatre' vinescrub, 25.13S, 148.59E, 5 Mar. 1998, C.J. Burwell (QMBA); 8♀, 5♂, Maroochy Hort Res Stn, Nambour, 8–15 Mar. 1985, M.T. (ASCU); 1♂, Mt Aberdeen, 20.12S, 147.55E, 8. Apr. 1997, C.J. Burwell (QMBA); 1♂, Mt Glorious, 27.20S, 152.46E, 11 Mar. 1998, C.J. Burwell (QMBA); 4♀, 27♂, Mt Glorious, 630 m, 28 Feb.–9 Mar. 1984, L. Masner, M.T. (CNCI); 1♀, Mt Glorious, 28 Feb. 1984, I.D. Galloway, sweeping (ASCU); 3♀, 1♂, Mooloolah, A.P. Dodd (ANIC); 1♀, 1♂, Mt Tamborine, Mar. 1928, A.P. Dodd (ANIC); 1♂, Mt Tamborine N.P., 3 Mar. 1984, L. Masner (CNCI); 3♂, Mt Tennison-Wood, via Mt Glorious, 13 Mar. 1977, I.D. Naumann (ANIC); 1♂, Ravenshoe, Jan. 1932, A.P. Dodd (ANIC); 1♀, Upper Hall Creek via Carmilla, 21.52S, 149.18E, 4 Dec. 1996–6 Apr. 1997, Monteith & Mulder (QMBA); 1♂, Westwood, Feb. 1926, A.P. Dodd (ANIC). **New South Wales:** 1♂, 30 miles S Singleton, Putty Road, 6 Feb. 1968, D.H. Colless (ANIC). **Australian Capital Territory:** 1♀, 2♂, Black Mountain, Feb.



Figs 8.171–8.173. *Scelio orientalis* Dodd: **8.171.** ♀ Holotype, dorsal head to T4. **8.172.** ♀ Holotype, anterior head. **8.173.** Distribution map. Scale lines: 0.25 mm.

and Dec. 1982, I.D. Naumann, J.C. Cardale, M.E. Matthews, M.T. (ANIC); 1 ♀, Canberra, 18 Jan. 1980, D.F. Rentz, ex swimming pool, (ANIC). **Victoria:** 1 ♂, Mitta Mitta Creek, 25 km NNW Omeo, 28 Feb. 1980, I.D. Naumann, J.C. Cardale (ANIC).

Female

Length

3.7–4.1 mm (mean 3.9 mm).

Colour

Dark brown except legs yellow.

Head

Width between eyes $2.18\text{--}2.3 \times$ width of head in dorsal view; OOL 0.06–0.08 mm; LOL 0.16–0.2 mm; POL 0.29–0.34 mm; ocellar diameter 0.08–0.09 mm, $0.16\text{--}0.18 \times$ width between eyes; head with fine short translucent pilosity; occiput rugulose; posterior vertex punctate-reticulate; medial vertex punctate; dorsal frons with rounded punctation; ventral frons rugulose to longitudinally striate; malar region with radiating striae, reaching halfway up frons; malar space $0.38\text{--}0.43 \times$ as long as eye height; interantennal process narrow ventrally, broad dorsally, lateral carinae continuing around antennal sockets, not extending onto frons; clypeus moderately produced between lateral points, with medial margin straight to convex; anteclypeus defined by raised smooth area; mandibles with faint reticulate sculpturing at extreme base, lower tooth $0.6\text{--}0.71 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity moderately long, fine, golden; dorsal pronotum rugose to punctate posteriorly; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum smooth anteriorly, rugose-reticulate posteriorly; pronotal shoulders prominent, defined by transverse carina;

scutum with evenly distributed rounded punctures; notauli defined by crenulate furrow; scutellum punctate-reticulate, no lateral spines defined; dorsellum prominent, not emarginate; mesopleuron moderately finely punctate-reticulate, with slight longitudinal trend; mesosternum evenly punctate; propodeum $0.33\text{--}0.46 \times$ as long as wide, rugose-reticulate about medial longitudinal furrow, with fine white pilosity laterally, postero-lateral area square or sometimes acute; indentation about nucha absent (some specimens appearing slightly indented antero-dorsally).

Wings

Moderately infusate, with fine dark setae; stigmal spot defined, with long stigmal vein.

Metasoma

$2.18\text{--}2.3 \times$ as long as wide, with fine pilosity; T1 $0.9\text{--}1.1 \times$ as long as upper anterior width, $0.9\text{--}1.04 \times$ as long as lower anterior width, strigose to rugose-reticulate; T2 longitudinally striate, becoming smoother medially; T3 longitudinally strigose, with medial area either smooth or reticulate; T4–T5 longitudinally strigose; T6 rugulose; S1–S2 rugulose basally, smooth with fine scattered punctation apically; S3–S5 mostly smooth, with fine scattered punctation, sometimes with faint striation or reticulation in extreme lateral part; S2 with shallow basal transverse ridge; S2–S3 with felt nodes defined.

Male

As for female, except tyloid on segment 5 present but not clearly defined.

Distribution

This species is found along the east coast of Australia from Victoria to north Queensland (Fig. 8.173).

Host

Praxibulus insolens (Baker *et al.* 1996) (see Table 4.2).

Comments

In the phylogenetic analyses (Figs 6.1, 6.2) *S. orientalis* is not resolved from *S. striatifacies* and the clade *S. gobar* + *S. pseudaustralis* + *S. miki* + *S. setiger* + *S. pembertoni* + *S. varipunctatus*, yet can be distinguished from these by the propodeum not being indented about the nucha, and the prominent dorsellum. It is similar to *S. asperatus* and *S. bipartitus* based on the form of the propodeum and the reticulate sculpturing of the basal mandible, but can be easily distinguished from these species by the interantennal process, which does not have carinae continuing onto the frons, and by the apical sternites, which are mostly smooth with scattered fine punctation.

SCELIO PARVICORNIS DODD

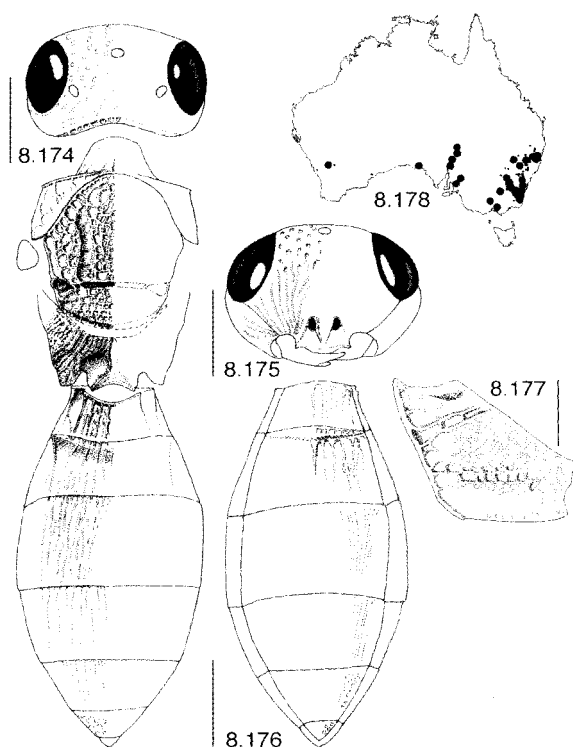
(Figs 8.174–8.178)

Scelio parvicornis Dodd, 1914b: 113.- Kieffer, 1926: 338; Dodd, 1927: 168; Galloway, 1976: 106; Galloway & Austin, 1984: 11; Johnson, 1992: 486.

Material examined

Holotype

♀, South Australia, 'S. Austr' (ANIC) (body in pieces on card with metanotum, most of legs, wings and antennae missing).



Figs 8.174–8.178. *Scelio parvicornis* Dodd: **8.174.** ♀ Holotype, dorsal habitus. **8.175.** ♀ Holotype, anterior head. **8.176.** ♀ Holotype, ventral metasoma. **8.177.** ♀ Holotype, mesopleuron. **8.178.** Distribution map of specimens examined during this study (large dots) and collection sites of Baker *et al.* (1996) (small dots). Scale lines: 0.25 mm.

Other material examined

New South Wales: 1 ♀, Ariah Park, 21 Dec. 1992, R. Pigott (ASCU); 3 ♀, Armidale, 18 Nov. 1981, G. Baker (ASCU); 1 ♀, Birriwah, 1 Oct. 1992, R. Pigott (ASCU); 5 ♀, Bombala, 17 Feb. 1982, G. Baker (ASCU); 14 ♀, Braidwood, 1 Dec. 1980, 29 Jan. 1981, Dec. 1981, R.A. Farrow (13, ASCU; 1, WINC); 3 ♀, Chakola, 24 Feb. 1982, G. Baker (ASCU); 1 ♀, Cooma, 19 Mar. 1982, G. Baker (ASCU); 1 ♀, Coonamble, 26 Jan. 1983, R. Pigott (ASCU); 1 ♀, Dumaresq, 4 Apr. 1981, G. Baker (ASCU); 1 ♀, Eurongilly, 26 Aug. 1992, ex eggs *C. terminifera*, R. Pigott (ASCU); 2 ♀, Goulburn, 19 Jan. 1983, G. Baker (ASCU); 1 ♀, Gunnedah, 14, Dec. 1992, R. Pigott (ASCU); 3 ♀, Jerangle, 12 Jan. 1982, G. Baker (ASCU); 1 ♀, Queanbeyan, 11 Jan. 1982, G. Baker (ASCU); 1 ♀, Oberon, 19 Feb. 1982, G. Baker (ASCU); 1 ♀, Walcha 11 Mar. 1979, G. Baker (ASCU); 1 ♀, West Wyalong, 'Oakhurst', 10 Dec. 1992, R. Pigott (ASCU); 1 ♀, Weethalle, 28 Jan. 1993, R. Pigott (ASCU); 2 ♀, Wollomombi, 6 Mar. and 22 Nov. 1982, G. Baker (ASCU). **Australian Capital Territory:** 13 ♀, Black Mountain, 7 Sep. 1931, bred from grasshopper eggs, A.T. Tonnoir (ANIC); 3 ♀, Canberra, 2 Jul. 1939, from eggs *A. cruciata* (ANIC); 2 ♀, Piccadilly Circus, Brindabella Ra., 35.22S, 148.49E, 24 Nov. 1981, J.C. Cardale (ANIC). **Victoria:** 1 ♀, Belgrave, 25 Dec. 1926, A.P. Dodd (ANIC); 1 ♀, Clunes, 6 Jan. 1956, Neboiss (ANIC). **South Australia:** 1 ♀, Brachina Gorge, 31.20S, 138.34E, 4–10 Nov. 1987, I. Naumann, J. Cardale, P.T. (ANIC); 1 ♂, Mylor 28 Dec. 1973–6 Jan. 1974, 10th Aust Boy Scout Camp Jamboree (ASCU); 3 ♀, 5 km S Mylor, 19 Jan. 1980, 13 Jan. 1981, A.D. Austin (ASCU); 1 ♀, 10 km WNW of Penong, 31.53S, 132.54E, 14 Oct. 1981, I.D. Naumann, J.C. Cardale (ANIC); 1 ♂, Waikerie, 6 Apr. 1997, M.J. Fletcher, J.S. Mann (WINC); 5 ♀, Wilpena Pound Gap, 31.33S, 138.36E, 5–10 Nov. 1987, I.D. Naumann, J.C. Cardale, P.T. (ANIC); 4 ♀, 7 ♂, Wilmington, May 1940, ex eggs *Austroicetes cruciata* (WINC). **Western**

Australia: 4 ♀, 1 ♂, Nungarin, 14 Sep. 1990, R.J. Dysart, ex egg pods of *C. terminifera* (USDA); 14 ♀, 6 ♂, Nungarin, P1Aus. F1, emer. 7 Mar.–4 Jun. 1991, Host: 'M. sang. A. elli. A. deor.' (USDA).

Female

Length

3.2–4.1 mm (mean 3.6 mm).

Colour

Dark brown except mandibles light brown.

Head

Width between eyes $0.49\text{--}0.56 \times$ width of head in dorsal view; OOL $0.02\text{--}0.03$ mm; LOL $0.19\text{--}0.25$ mm; POL $0.31\text{--}0.39$ mm; ocellar diameter $0.05\text{--}0.06$ mm, $0.1\text{--}0.14 \times$ width between eyes; head with short fine translucent pilosity; occiput rugose to rugulose; posterior vertex punctate-rugulose with transverse trend; medial vertex and dorsal frons smooth, with broad scattered punctation; ventral frons punctate-rugose; malar region with radiating striae, continuing dorsally above interantennal process; malar space $0.45\text{--}0.6 \times$ as long as eye height; interantennal process moderately short and narrow, with lateral carinae continuing around antennal sockets; clypeus moderately produced, convex between lateral points; anteclypeus defined by smooth raised marginal area; mandibles smooth, lower tooth short and small $0.25\text{--}0.33 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity sparse, short, fine; dorsal pronotum smooth to transversely strigose; latero-dorsal pronotum with faintly to moderately well defined rugose-reticulation; latero-ventral pronotum rugulose; pronotal shoulders prominent, well defined by transverse carina; scutum rugose-reticulate to punctate-reticulate; notauli defined by crenulate furrow; scutellum punctate-reticulate, no lateral spines defined; dorsellum only very slightly prominent, not emarginate; mesopleuron punctate-reticulate to rugulose-reticulate; mesosternum mostly smooth, with marginal punctation; propodeum $0.43\text{--}0.52 \times$ as long as wide, oblique reticulate striation, medial longitudinal furrow present, with sparse short fine white pilosity laterally, postero-lateral area square; indentation about nucha present.

Wings

Lightly infusate, slightly darker in apical two-thirds, with short fine setae; stigmal spot defined, with faintly infusate stigmal vein.

Metasoma

$2.02\text{--}2.4 \times$ as long as wide, with short fine sparse pilosity; T1 $0.6\text{--}0.81 \times$ as long as upper anterior width, $0.5\text{--}0.64 \times$ as long as lower anterior width, longitudinally strigose with background reticulation; T2 longitudinally strigose; T3 longitudinally strigose to reticulate; T4–T5 longitudinally striate, varying in strength; T6 rugose to punctate; S1–S2 longitudinally striate, S2 with basal transverse ridge; S3–S5 medially smooth, with faint lateral striation; S2 with low glabrous lateral felt fields defined.

Male

Generally as for female except dark brown, tibia and basal tarsomeres light brown; antennal segment 5 larger than segments 4 and 6, with elongate distinct tyloid on external surface; vertex with confused mixture of irregular striae and shallow broad punctures; mandibles with lower tooth $0.9 \times$ upper tooth; notauli moderately well defined; fore femur slightly swollen medially; ventro-medial mesosternum smooth; T2–T3 moderately finely

striate-reticulate, sometimes with small medial smooth patch; T5–T6 virtually smooth and shiny; S2–S3 smooth medially, longitudinally striate laterally, with felt nodes defined but weak on T3.

Distribution

This species is widely distributed in the southern part of Australia from New South Wales to Western Australia, and is found in both coastal and inland semi-arid habitats (Fig. 8.178).

Host

Austroicetes cruciata; *A. vulgaris* (Baker *et al.* 1985, 1996; Baker & Pigott 1993), *Brachyexarna lobipennis*, *Chortoicetes terminifera*, *Phaulcridium vittatum* (Baker *et al.* 1996). In addition, this species has been reared from the eggs of *Aulocara ellioti*, *Melanoplus sanguinipes* and *Ageneotettix deorum* under semi-laboratory conditions in the USA (Dysart 1991, 1992) (see Tables 4.2 and 4.3).

Comments

In the phylogenetic analysis *S. parvicornis* is the sister species of all other taxa that have male antennal tyloids (Fig. 6.2, node 9). It is superficially similar to *S. diemenensis* but can be distinguished by the well-defined notauli. It is also similar to *S. striatifacies*, but females can be distinguished by the shorter lower mandibular tooth, the darker coloured legs, the lower anterior width of T1 being slightly wider than the upper anterior width, and the slightly more prominent dorsellum.

Many male specimens, previously labelled *S. parvicornis* (ASCU), cannot be positively associated with females of this species, particularly with respect to the length of the lower mandibular tooth and the similarity of this species to *S. striatifacies* Dodd and *S. diemenensis* Dodd. However, females of *S. striatifacies* Dodd and *S. diemenensis* Dodd have not been recorded from South Australia or Western Australia in areas where *S. parvicornis* is commonly collected. Males and females from Wilmington, South Australia have been reared together from eggs of *A. cruciata* and also from Nungarin, Western Australia, from eggs of *C. terminifera*. These males have the mesosternum smooth and T4–T6 virtually smooth with slight fine strigosity laterally and scattered fine punctation from the associated pilosity. The male sex has therefore been described, based on material from South Australia and Western Australia. Specimens from these regions are most similar to males from species-group S but can be distinguished by the sculpturing of T2–T6.

SCELIO PERSPICUUS DODD

(Figs 8.179–8.181)

Scelio perspicuus Dodd, 1927: 140.- Galloway, 1976: 106; Galloway & Austin, 1984: 11; Johnson, 1992: 486.

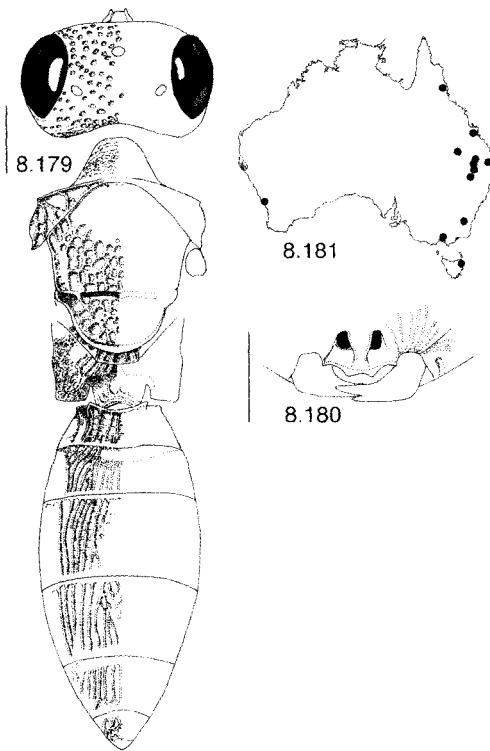
Material examined

Holotype

♀, Queensland, 'Chinchilla Queensland A.P. Dodd Jan. 1924' (SAMA).

Paratypes

Queensland: 2 ♀, same data as holotype (ANIC; QMBA). **New South Wales:** 1 ♀, Moree, Jan 1926, A.P. Dodd (ANIC); N.B. the ♂ paratype [same data as holotype] in ANIC is here excluded from the type series (see comments below).



Figs 8.179–8.181. *Scelio perspicuus* Dodd:
 8.179. ♀ Holotype, dorsal habitus.
 8.180. ♀ Holotype, lower anterior head.
 8.181. Distribution map. Scale lines:
 0.25 mm.

Other material examined

Queensland: 1 ♀, Brisbane, May 1977, K. Houston, M.T. (ASCU); 3 ♀, Chillagoe on road to Mareeba, 17.12S, 144.33E, 28 Mar.–3 Apr. 1992, E.C. Dahms, G. Sarnes (QMBA); 17 ♀, Chinchilla, Jan.–Mar. 1928, A.P. Dodd (16, ANIC; 1, ASCU); 2 ♀, Condamine, 31 Jan. 1935, B.A. Smith (ANIC); 1 ♀, Gogango, Mar. 1928, A.P. Dodd (ANIC); 5 ♀, Goondiwindi, Jan. and Oct. 1928, 7 Dec. 1932, A.P. Dodd (ANIC); 1 ♀, Morven, A.P. Dodd (ANIC). **New South Wales:** 1 ♀, Kiandra, 25 Feb. 1963, E.F. Riek (ANIC). **Victoria:** 1 ♀, Belgrave, 24 Dec. 1926, A.P. Dodd (ANIC). **Tasmania:** 1 ♀, Coles Bay, 13 Jan. 1948, E.F. Riek (ANIC). **Western Australia:** 1 ♀, Mt Cooke, 17 Feb.–18 Apr. 1991, M.S. Harvey and J.M. Waldock, M.T. (WINC).

Female

Length

3.8–4.4 mm (mean 4.2 mm).

Colour

Brown except legs, mandibles and basal antennae yellow.

Head

Width between eyes $0.48\text{--}0.54 \times$ width of head in dorsal view; OOL $0.03\text{--}0.04$ mm; LOL $0.24\text{--}0.28$ mm; POL $0.38\text{--}0.45$ mm; ocellar diameter $0.08\text{--}0.09$ mm, $0.11\text{--}0.17 \times$ width between eyes; head with short fine translucent pilosity; occiput faintly rugulose; posterior vertex punctate-reticulate with transverse trend; medial vertex and dorsal frons, with moderately dense punctation; ventral frons punctate-reticulate; malar region with radiating

striae, continuing onto frons above interantennal process; malar space $0.47\text{--}0.56 \times$ as long as eye height; interantennal process short, with lateral carinae continuing around antennal sockets, not onto frons; clypeus produced between lateral points, with medial margin slightly concave; anteclypeus defined by raised smooth marginal area; mandibles smooth, lower tooth $0.43\text{--}0.57 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, moderately long, translucent, sometimes with orange tinge; dorsal pronotum transversely rugulose anteriorly to irregularly pustulate posteriorly; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum smooth anteriorly, rugose posteriorly with longitudinal trend; pronotal shoulders prominent, defined by transverse carina; anterior scutum mostly smooth; posterior scutum punctate-reticulate, lateral scutum punctate-reticulate to rugose-reticulate; notauli poorly defined amongst sculpturing; scutellum punctate-reticulate, no lateral spines defined; dorsellum prominent, very slightly to not emarginate medially; mesopleuron rugulose-punctate; mesosternum punctate; propodeum $0.35\text{--}0.43 \times$ as long as wide, rugose with oblique trend, short medial longitudinal furrow present anteriorly, with sparse short fine pilosity laterally, postero-lateral area square; indentation about nucha deep and narrow.

Wings

Lightly infusate, with short fine setae; stigmal spot poorly defined by faint infuscation, stigmal vein absent.

Metasoma

$2.05\text{--}2.35 \times$ as long as wide, with short fine sparse pilosity; T1 $0.59\text{--}0.67 \times$ as long as upper anterior width, $0.43\text{--}0.5 \times$ as long as lower anterior width, longitudinally strigose with background reticulation; T2–T5 longitudinally strigose, T3–T4 with medial reticulation; T6 rugose-reticulate; S1–S5 longitudinally strigose, S3–S5 smooth with scattered punctation medially, S2 with basal transverse ridge and furrow; S2–S3 with moderately well-defined felt nodes.

Male

Unknown.

Distribution

This species is known from eastern Australia (Tasmania to east-northern Queensland), but is also known by one specimen from south-western Western Australia (Fig. 8.181).

Host

Unknown.

Comments

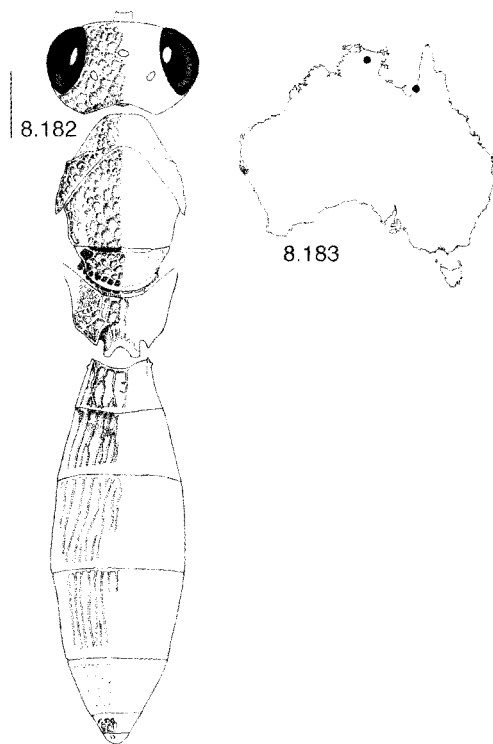
This species can be recognised by the short lower mandibular tooth, the short propodeum, and smooth anterior scutum. In the phylogenetic analysis (Fig. 6.2) it is the sister species of *S. schmelio* + *S. notabilis* + *S. mareebaensis* + *S. zborovskii*, although they are not defined by any unequivocal synapomorphies. It can be distinguished from these species by the reduction of the sculpturing on the anterior scutum. A specimen from Acacia Ridge, south-east Queensland (ANIC) has tentatively been assigned to this species but it has an orange mesosoma and brown scutellum. If further specimens with this distinctive colour pattern are collected and the character appears to be consistent, they may need to be considered as a new species.

The one male paratype from Chinchilla (ANIC) cannot be positively associated with the female sex of this species. It differs from the female by having brown coxae, the mandibular teeth subequal in length, the vertex coarsely punctate-reticulate, the anterior scutum sparsely punctate, and is generally more heavily sculptured (as is the case for males of most species). For this reason and to guard against potential confusion in the future, the male paratype should be considered as not being conspecific with the Holotype

It is placed in species-group 'O' with a series of males from the same locality collected at the same time, along with other more recently collected specimens from northern Queensland. Males for this species are inferred from the phylogenetic analysis as lacking antennal tyloids.

***SCELIO PETILUS* DANGERFIELD & AUSTIN SP. NOV.**

(Figs 8.182, 8.183)



Figs 8.182, 8.183. *Scelio petilus* sp. nov.:

8.182. ♀ Holotype, dorsal habitus.

8.183. Distribution map. Scale line:
0.25 mm.

Material examined

Holotype

♀, Northern Territory, 'Kakadu N.T. 17.iv.1992, W. Houston' 'T501.K2197' (ANIC).

Paratype

Queensland: 1 ♀, Norman River, Karumba, 3–17 Nov. 1979, W.A. Houston, M.T. mangrove–salt marsh boundary (ANIC).

Female

Length

4.3–4.5 mm (mean 4.4 mm).

Colour

Head, clava, mesosoma and metasoma dark brown to black; mandibles and coxae medium brown, remainder of legs and basal antenna yellow.

Head

Width between eyes $0.49 \times$ width of head in dorsal view; OOL 0.05–0.06 mm; LOL 0.16–0.17 mm; POL 0.3 mm; ocellar diameter 0.07–0.09 mm, $0.15\text{--}0.2 \times$ width between eyes; head with fine sparse moderately long pilosity; occiput with moderately fine punctation; posterior and medial vertex punctate-reticulate to rugose-reticulate; frons with coarse punctation; malar region with short radiating striae between interantennal process and ventral eye, punctate about speculum; malar space $0.41\text{--}0.45 \times$ as long as eye height; interantennal process long and narrowed ventrally, with lateral carina continuing around antennal sockets, not onto frons; clypeus produced between moderately long lateral points, medial margin straight; anteclypeus defined by raised smooth marginal area; mandibles smooth, lower tooth $0.57\text{--}0.6 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, long, translucent; dorsal pronotum irregularly punctate to rugulose; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum smooth anteriorly, punctate-reticulate medially, striate posteriorly; pronotal shoulders prominent, defined by transverse carina; scutum punctate laterally, punctate-reticulate medially; notauli not defined; scutellum punctate-reticulate, no lateral spines defined; dorsellum not prominent, low and broad, only very slightly raised above level of lateral metanotum, not emarginate; mesopleuron and mesosternum with moderately fine punctation; propodeum long and narrow, $0.52\text{--}0.56 \times$ as long as wide, punctate-reticulate laterally to rugose antero-medially, medial longitudinal furrow present, with fine white pilosity laterally, postero-lateral area tapering to a point; indentation about nucha present.

Wings

Moderately infusate, with moderately long fine light brown setae; stigmal spot defined as irregular opaque buff-coloured area, stigmal vein absent.

Metasoma

$2.71\text{--}2.79 \times$ as long as wide, with fine moderately long scattered pilosity; T1 $0.83\text{--}0.88 \times$ as long as upper anterior width, $0.80\text{--}0.83 \times$ as long as lower anterior width, longitudinally strigose; T2–T4 longitudinally striate, T3 and T4 with narrow postero-medial smooth patch, T5 mostly smooth, with fine scattered punctation associated with pilosity; T6 punctate-reticulate; S1–S5 with coarse longitudinally strigosity, S2 with basal transverse ridge; S2–S3 with raised longitudinally elongate, finely punctate, mostly glabrous, felt nodes defined.

Male

Unknown.

Distribution

Scelio petilus is known from only two specimens collected from Kakadu, Northern Territory, and the south-western side of Cape York Peninsula (Fig. 8.183).

Host

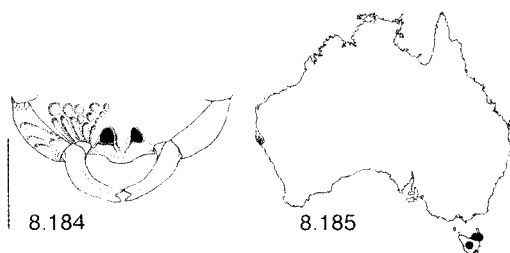
Unknown.

Comments

In the phylogenetic analysis *S. petilus* is the sister species of *S. erythropus*, although they are not defined by any unequivocal characters (see comments under *S. erythropus*). It can be distinguished from all other Australian species by the broad pronotal collar (Fig. 8.182). Males for this species are inferred from the phylogenetic analysis as having antennal tyloids. It is named after the Latin 'petilus' meaning 'thin' or 'slender'.

SCELIO PIGOTTI DANGERFIELD & AUSTIN SP. NOV.

(Figs 8.184, 8.185)



Figs 8.184, 8.185. *Scelio pigotti* sp. nov.: **8.184.** ♀ Holotype, lower anterior head. **8.185.** Distribution map. Scale line: 0.25 mm.

Material examined

Holotype

♀, Tasmania, '41.23S 147.25E Mt Barrow 11 km E by N Nunamara TAS. 30 Jan 1983 I.D. Naumann & J.C. Cardale ex ethanol' (ANIC).

Paratypes

Tasmania: 3 ♀, 1 km SSE Gladstone, 40.58S, 148.01E, 29 Jan. 1983, (1 ♀) 6 Feb. 1983, I.D. Naumann & J.C. Cardale (ANIC); 1 ♀, Mt Field Nat. Pk, 8–14 Jan. 1984, L. Masner, M.T. (CNCI).

Female

Length

3.5–4.2 mm (mean 3.9 mm).

Colour

Dark brown except legs, mandibles and basal antennae yellow, coxae red-brown.

Head

Width between eyes $0.46\text{--}0.47 \times$ width of head in dorsal view; OOL 0.03 mm; LOL 0.23 mm; POL 0.34 mm; ocellar diameter 0.08 mm, $0.16 \times$ width between eyes; pilosity moderately coarse on temples and frons, fine on medial vertex; occiput strigose; posterior vertex transversely strigose to punctate-strigose; medial vertex punctate; frons punctate to punctate-reticulate; malar region with short radiating striae, becoming punctate immediately above level of interantennal process; malar space $0.47\text{--}0.48 \times$ as long as eye height; interantennal process smooth, with lateral carinae continuing around antennal sockets; clypeus moderately produced between lateral points, with medial margin slightly concave; anteclypeus defined by raised smooth area; mandibles smooth, lower tooth about equal in length to upper tooth, dorsal tooth absent.

Mesosoma

Pilosity coarse on lateral pronotum, otherwise moderately fine; dorsal pronotum rugulose; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum rugulose to punctate-reticulate; pronotal shoulders weakly defined by low transverse carina almost reaching scutum; anterior and lateral scutum punctate, posterior scutum punctate-reticulate; notauli defined and crenulate; scutellum punctate-reticulate, no lateral spines defined; dorsellum prominent, emarginate with lateral points; mesopleuron striate; mesosternum mostly smooth, with sparse fine punctation; propodeum $0.4 \times$ as long as wide, rugose about medial longitudinal furrow, with sparse fine pilosity laterally, postero-lateral area square; indentation about nucha present.

Wings

Moderately infusate, with fine short dark setae; small infusate stigmal spot defined, with infusate stigmal vein.

Metasoma

$1.8\text{--}2.1 \times$ as long as wide, fine short pilosity laterally; T1 $0.43\text{--}0.47 \times$ as long as upper anterior width, $0.27\text{--}0.31 \times$ as long as lower anterior width, longitudinally strigose; T2 longitudinally strigose; T3 rugose-reticulate medially, becoming strigose laterally; T4–T5 strigose; T6 punctate-foveolate; S1–5 strigose laterally, mostly smooth medially, with sparse punctation; S2 with basal transverse ridge; S2–S3 without felt lines or nodes defined.

Male

Unknown.

Distribution

Scelio pigotti is restricted to Tasmania (Fig. 8.185).

Host

Unknown.

Comments

In the phylogenetic analysis *S. pigotti* is the sister species of *S. improcerus* (see comments under *S. improcerus*). It is similar to *S. contractus* Dodd and is possibly a junior synonym of this species. However, it has been described as new because of several apparently fixed morphological differences, viz. the form of the dorsellum, the sculpturing on the posterior vertex, and the colour of the coxae, as well as its allopatric distribution. Males for this species are inferred from the phylogenetic analysis as lacking antennal tyloids. The males from Tasmania, treated below as species group 'P', may belong to *S. pigotti* based on collection date and locality. This species is named after Raymond Pigott, in honour of his work in rearing and collecting *Scelio* in Australia.

SCELIO PILOSIFRONS DODD

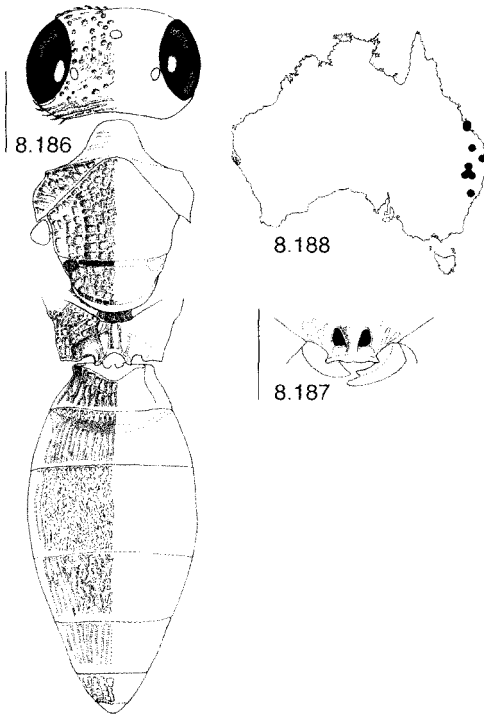
(Figs 8.186–8.188)

Scelio pilosifrons Dodd, 1927: 152.- Galloway, 1976: 106; Galloway & Austin, 1984: 11; Johnson, 1992: 486.

Material examined

Holotype

♀, Queensland, 'Brisbane Feb. 1917' (SAMA).



Figs 8.186–8.188. *Scelio pilosifrons* Dodd: **8.186.** ♀ Paratype, dorsal habitus. **8.187.** ♀, lower anterior head, showing reduced clypeus with medial cleft on margin. **8.188.** Distribution map. Scale lines: 0.25 mm.

Paratypes

Queensland: 1♀, same data as holotype (SAMA); 1♀, Chinchilla, no date, A.P. Dodd (ANIC); 1♀, Goondiwindi, Dec. 1925, A.R. Taylor (QMBA).

Other material examined

Queensland: 21♀, Chinchilla, no date, Jan. 1926 1927 1928, Feb. 1928, Mar. 1928, A.P. Dodd (ANIC); 1♀, Gogango, Oct. 1932, A.P. Dodd (ANIC); 3♀, Goondiwindi, Jan. 1928, A.P. Dodd (ANIC); 1♀, Westwood, Feb. 1928, no collector (ANIC). **New South Wales:** 4♀, Gravesend, Apr. 1928, A.P. Dodd (ANIC); 3♀, Moree, Nov. 1925, Jan. & Mar. 1926, A.P. Dodd (ANIC); 4♀, Scone, Feb. 1931, A.P. Dodd (ANIC); 6♀, Wincalda, 30 Oct. 1927, A.P. Dodd (ANIC).

Female

Length

3.4–3.8 mm (mean 3.65 mm).

Colour

Dark to medium brown except legs, mandibles, tegulae and antennae yellow to light brown/yellow.

Head

Width between eyes $0.48\text{--}0.53 \times$ width of head in dorsal view; OOL $0.009\text{--}0.013$ mm; LOL $0.24\text{--}0.28$ mm; POL $0.36\text{--}0.41$ mm; ocellar diameter 0.06 mm, $0.12\text{--}0.14 \times$ width between eyes; head with coarse stout translucent pilosity; occiput rugulose; posterior vertex with transverse rugulae; medial vertex with moderately sparse coarse punctures, sometimes with faint crenulae between; frons with moderately coarse punctation; malar region punctate;

malar space $0.55\text{--}0.69 \times$ as long as eye height; interantennal process short, broad, with lateral carinae continuing around antennal sockets, not onto frons; clypeus not produced between lateral points, with medial margin slightly even, convex or with cleft medially; anteclypeus defined by raised smooth marginal area; mandibles smooth, only just overlapping medially when closed, lower tooth $1.8\text{--}3.3 \times$ upper tooth, dorsal tooth absent.

Mesosoma

With coarse moderately long translucent pilosity laterally, finer on anterior scutum; dorsal pronotum faintly rugulose; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum smooth anteriorly, becoming strigose posteriorly; pronotal shoulders prominent, defined by transverse carina; scutum, rugose-reticulate to punctate-reticulate, slightly coarser anteriorly; notauli well defined by crenulate furrow; scutellum rugose-reticulate, no lateral spines defined; dorsellum prominent, very slightly emarginate; mesopleuron obliquely striate to strigose; mesosternum smooth medially with sparse punctures, rugulose laterally; propodeum $0.38\text{--}0.4 \times$ as long as wide, rugose-reticulate laterally, medial longitudinal furrow present, with fine sparse translucent pilosity laterally, postero-lateral area square; indentation about nucha shallow and broad.

Wings

Lightly infusate, with short fine setae; stigmal spot defined by moderate infuscation, with poorly defined slightly infusate stigmal vein.

Metasoma

$1.95\text{--}2.1 \times$ as long as wide, with sparse fine pilosity; T1 $0.37\text{--}0.43 \times$ as long as upper anterior width, $0.28\text{--}0.31 \times$ as long as lower anterior width, rugose-reticulate with longitudinal trend; T2 faintly longitudinally strigose; T3 reticulate; T4 broadly reticulate medially, strigose laterally, T5 longitudinally striate; T6 rugose; S1–S5 reticulate, S3–S5 smoother posteriorly, S2 with basal transverse ridge and furrow; S2–S3 without felt lines or nodes defined.

Male

Unknown.

Distribution

Scelio pilosifrons is known from southern Queensland and northern New South Wales (Fig. 8.188).

Host

Unknown.

Comments

This species is unique in having the upper mandibular tooth shorter than the lower one, and the mandibles only just meeting medially when closed. It can also be distinguished by the clypeus not being produced between the lateral points. *Scelio pilosifrons* is the sister species of *S. unidentis* although they are not defined by any unequivocal synapomorphies. They can be distinguished in that *S. pilosifrons* has two apical mandibular teeth, the malar region with punctuation, the latero-ventral pronotum with an anterior smooth patch, the dorsellum only slightly emarginate, and a distinct basal transverse ridge on S2. The species *S. chortoicetes* + *S. pilosifrons* + *S. unidentis* form a clade that has the mandibles modified. Females of *S. chortoicetes* and *S. unidentis* have only one apical mandibular tooth while *S. pilosifrons* has shortened mandibles which only just meet medially and have a much reduced upper apical tooth (Fig. 8.187). This arrangement may have resulted from the reduction of the upper tooth rather than lower tooth, as in *S. nanocuspis* (Fig. 8.151). All three species do not have the

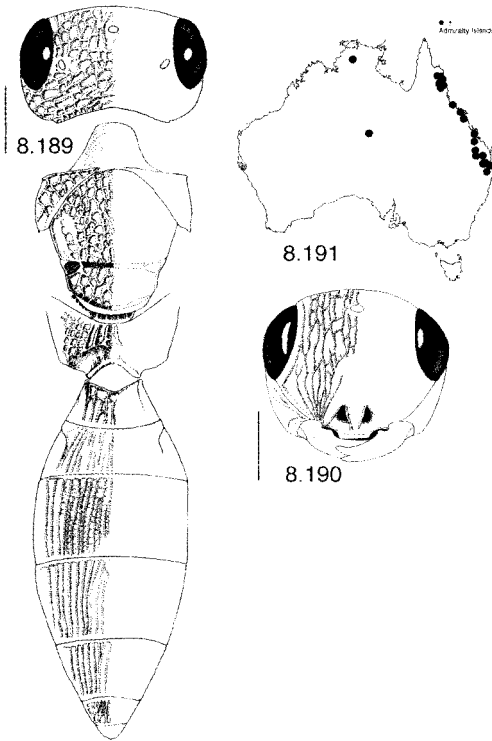
clypeus produced into lateral points (Figs 8.32, 8.187, 8.225), and have the malar region faintly punctate. Males for this species are inferred from the phylogenetic analysis as lacking antennal tyloids.

SCELIO PILOSUS DODD STAT. REV.

(Figs 8.189–8.197)

Scelio pilosus Dodd, 1913a: 137, 138; Kieffer, 1926: 341; Dodd, 1927: 162 (synonymised with *S. flavicornis* Dodd); Galloway, 1976: 105. **Stat. rev.**

Scelio pilosiceps Dodd, 1914b: 116; Kieffer, 1926: 341; Dodd, 1927: 162 (synonymised with *S. flavicornis* Dodd); Galloway, 1976: 105. **Syn. nov.**



Figs 8.189–8.191. *Scelio pilosus* Dodd:
8.189. ♀ Holotype, dorsal habitus.
8.190. ♀, anterior head. 8.191. Distribution
map. Scale lines: 0.25 mm.

Material examined

Holotype

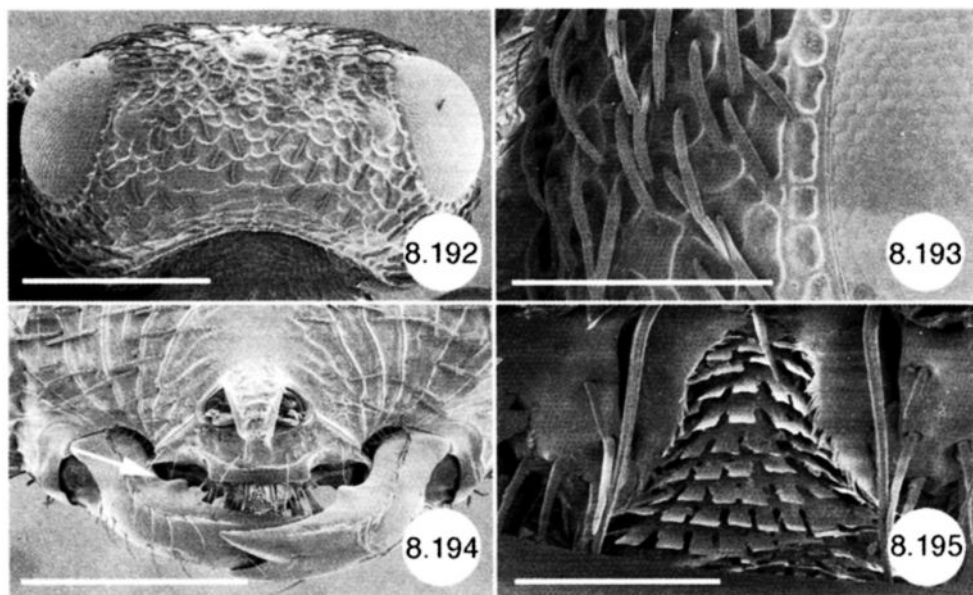
♀ (*S. pilosus*), Queensland, 'Cairns dist. A.M. Lea' (SAMA); ♀ (*S. pilosiceps*) pointed specimen and slide mount of antennae and wings, no data labels (SAMA).

Paratype

Queensland: 1 ♀, Brisbane, 26 Oct. 1916, H. Hacker (QMBA).

Other material examined

Queensland: 1 ♀, Ayr, 30 Sep. 1960, R.D. Hughes (ANIC); 1 ♀, Bald Mt area via Emu Vale, 21–31 Jan. 1972, S.R. Monteith (ANIC); 2 ♀, Brisbane, no date, A.P. Dodd (ANIC); 1 ♀,



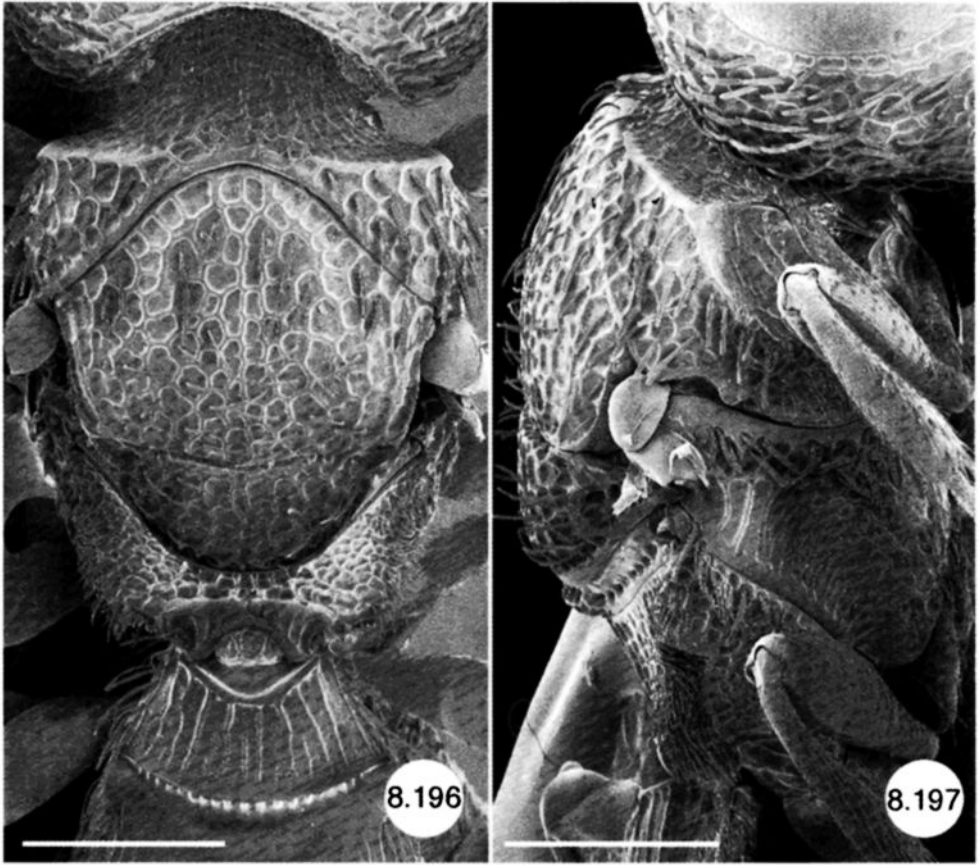
Figs 8.192–8.195. *Scelio pilosus* Dodd, ♀: **8.192.** Dorsal head. **8.193.** Detail of lateral head, showing coarse 'feather-like' setae. **8.194.** Lower anterior head, showing dorsal mandibular tooth (arrowed). **8.195.** Glossa. Scale lines: 8.192, 8.194, 0.4 mm; 8.193, 0.2 mm; 8.195, 40 µm.

Brisbane, Indooroopilly DPI, 10–17 Dec. 1984, no collector (WINC); 1 ♀, Boggom via Taroona, 25.27S, 150.03E, 11 Nov. 1996–Jan. 1997, Cook, Monteith (QMBA); 1 ♀, Carr Ck, 18 km NNW Mareeba, 21 May 1980, I.D. Naumann, J.C. Cardale (ANIC); 3 ♀, Chillagoe, 17S, 144E, Mar. Apr. 1992, E.C. Dahms, G. Sarnes (QMBA); 4 ♀, Chinchilla, Feb. 1927, A.P. Dodd (ANIC); 1 ♀, Chinchilla, Mar. 1927, B.A. Smith (ANIC); 1 ♀, Deadman Ck, 9 km S Proserpine, 10 May 1980, J.C. Cardale, I.D. Naumann (ANIC); 1 ♀, Gatton, 7–14 Oct. 1981, ex P.T. in potato crop, no collector (QDPC); 1 ♀, Gordonvale, Jan. 1920, no collector (ANIC); 1 ♀, Kingaroy, 16 Apr. 1927, A.P. Dodd (ANIC); 1 ♀, 5 km SW Kuranda, 17 May 1980, J.C. Cardale, I.D. Naumann (ANIC); 2 ♀, Lake Broadwater via Dalby, 19–22 Nov. 1986, no collector (QDPC); 2 ♀, Malanda, Mar. 1921, no collector (ANIC); 3 ♀, Mareeba, 2–10 Jul. 1992, D.H. Habeck, M.T. (CNCI); 1 ♀, 10 km SW Mareeba, 26 Apr. 1974, J.F. Donaldson (QDPC); 1 ♀, Mt Glorious, 27.20S, 152.46E, 11 Mar. 1998, C.J. Burwell (QMBA); 3 ♀, Mt Glorious NP, Feb. 1989, H. Howden (CNCI); 1 ♀, Mt Halifax summit, 19.07S, 146.23E, 21 Mar.–10 May 1991, D. Cook (QMBA); 1 ♀, Upper Hall Creek, 12 km WNW Carmilla, 21.52S, 149.18 E, 6 Apr. 1997, C.J. Burwell (QMBA); 1 ♀, Westwood, Nov. 1927, A.P. Dodd (ANIC). **New South Wales:** 1 ♀, Wiangaree NP, Brindle Creek, 15 Feb. 1984, L. Masner (CNCI). **Northern Territory:** 1 ♀, Emily Gap, 9 km SE by Alice Springs, 23.45S, 133.57E, 18 May 1978, J.C. Cardale (ANIC); 1 ♀, 3 km SSW Katherine, 14.30S, 132.15E, 12 Nov. 1979, I.D. Naumann (ANIC). **Papua New Guinea.** 1 ♀, Admiralty Islands, 1932, N. Caldwell, ex Acridid eggs (ANIC).

Female

Length

3.5–4.0 mm (mean 3.8 mm).



Figs 8.196, 8.197. *Scelio pilosus* Dodd, ♀: 8.196, dorsal mesosoma and T1. 8.197, lateral mesosoma. Scale lines: 0.4 mm.

Colour

Dark brown except coxae light to mid brown, distinctly darker than rest of legs which are yellow.

Head

Width between eyes $0.56\text{--}0.6 \times$ width of head in dorsal view; OOL 0.03 mm; LOL 0.26–0.31 mm; POL 0.46–0.56 mm; ocellar diameter 0.05–0.06 mm, $0.09\text{--}0.11 \times$ width between eyes; head with long coarse feather-like white pilosity, becoming finer with tan colour on medial vertex; occiput rugulose; posterior vertex rugulose-reticulate; medial vertex to dorsal frons rugulose-reticulate; ventral frons longitudinally strigose; malar region with radiating striae, becoming strigose dorsally; malar space $0.63\text{--}0.67 \times$ as long as eye height; interantennal process narrow, with lateral carinae continuing around antennal sockets, not onto frons; clypeus well produced between lateral points, with medial vertex straight and spade-like; anteclypeus not clearly defined; mandibles smooth, lower tooth $0.9\text{--}0.95 \times$ upper tooth, dorsal tooth present and strongly defined

Mesosoma

Pilosity fine on dorsal pronotum, otherwise coarse, long, feather-like and white elsewhere, becoming tan coloured on medial scutum and scutellum; dorsal pronotum with fine

punctuation; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum smooth anteriorly, becoming rugose-reticulate posteriorly; pronotal shoulders prominent, defined by transverse carina; scutum rugose-reticulate; notauli not defined amongst sculpturing of scutum; scutellum rugose-reticulate, no lateral spines defined; dorsellum moderately prominent, not emarginate; mesopleuron rugulose reticulate with oblique transverse trend; mesosternum punctate-reticulate; propodeum $0.44\text{--}0.5 \times$ as long as wide, rugose-reticulate, short medial longitudinal furrow present, with coarse white pilosity laterally, postero-lateral area rounded; indentation about nucha absent.

Wings

Lightly infusate, with short fine light brown setae; stigmal spot defined as light brown area, with short stigmal vein.

Metasoma

$2.31\text{--}2.48 \times$ as long as wide, with coarse long feather-like white pilosity laterally; T1 $0.67\text{--}0.83 \times$ as long as upper anterior width, $0.61\text{--}0.77 \times$ as long as lower anterior width, rugose-reticulate; T2 very faintly longitudinally striate; T3–T5 longitudinally striate, becoming fainter and reticulate medially; T6 rugulose-reticulate; S1 rugose-reticulate; S2–S5 strigose laterally, smooth medially, S2 with transverse basal ridge; S2–S3 with raised finely striate felt nodes defined.

Male

Unknown.

Distribution

Scelio pilosus is found along the coastal margin of northern New South Wales, Queensland, from the Northern Territory, and the Admiralty Islands of New Guinea (Fig. 8.191).

Host

The female specimen from Admiralty Islands, New Guinea is recorded as emerging from acridid eggs.

Comments

This species has been removed from synonymy with *S. flavicornis* as there is no evidence to link the male holotype of *S. flavicornis* with the female types of *S. pilosus* and *S. pilosiceps*. *Scelio pilosus* is very similar to *S. setafascis* but can be distinguished by having brown coxae and the wings lacking longer coarser microtrichia apically. It also resembles females of *S. locustae* but can be distinguished by the produced straight clypeal margin. The relationships of this species are discussed under *S. borroloolensis*.

SCELIO PLANITHORAX DODD

(Figs 8.198, 8.199)

Scelio planithorax Dodd, 1927: 174. Galloway, 1976: 106; Galloway & Austin, 1984: 11; Johnson, 1992: 486.

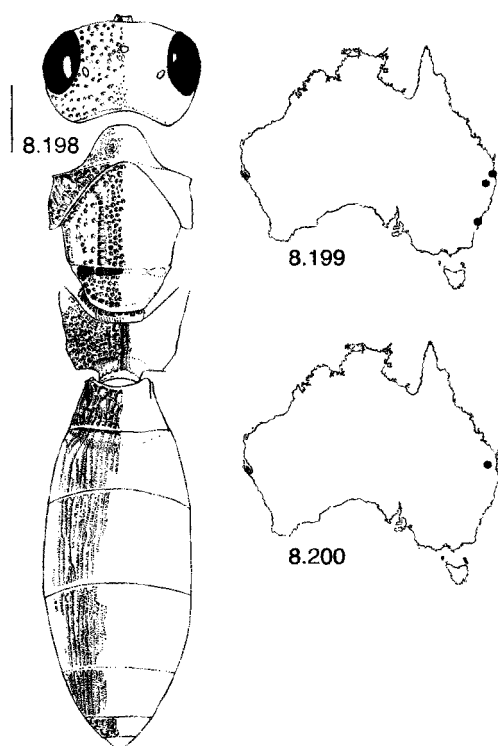
Material examined

Holotype

♀, Queensland, 'Mt. Tambourine Queensland A.P. Dodd' 'April 1926' (SAMA).

Paratype

Queensland: ♀, same data as holotype (ANIC).



Figs 8.198, 8.199. *Scelio planithorax* Dodd: 8.198. ♀ Paratype, dorsal habitus. 8.199. Distribution map. Scale lines: 0.4 mm. 8.200. *Scelio pseudaustralis* sp. nov., distribution map.

Other material examined

New South Wales: 1 ♀, Glen Innes, 24 Feb. 1977, G. Baker, parasites of eggs of *G. musicus* (ASCU); 1 ♀, Kangaroo Valley, 22 Mar. 1961, E.F. Riek (ANIC).

Female

Length

4.2–4.3 mm (mean 4.25 mm).

Colour

Dark to medium brown except legs, mandibles and basal antennae yellow.

Head

Width between eyes $0.53\text{--}0.57 \times$ width of head in dorsal view; OOL 0.03 mm; LOL 0.22–0.23 mm; POL 0.4–0.45 mm; ocellar diameter 0.06 mm, $0.12\text{--}0.13 \times$ width between eyes; head with fine translucent pilosity; occiput finely punctate; posterior vertex punctate to punctate-reticulate; medial vertex smooth, with moderately sparse punctation; frons punctate; malar region with radiating striae, continuing and becoming reticulate above level of interantennal process; malar space $0.53\text{--}0.56 \times$ as long as eye height; interantennal process narrow, with lateral carinae continuing around antennal sockets, not onto frons; clypeus well produced between lateral points, with medial margin narrow and straight; anteclypeus defined by raised smooth marginal area; mandibles smooth, lower tooth $0.75\text{--}0.88 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, moderately long, translucent; dorsal pronotum rugulose anteriorly to finely punctate posteriorly; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum

finely punctate anteriorly, with punctuation becoming coarser and reticulate posteriorly; pronotal shoulders prominent, defined by transverse carina; dorsal scutum with moderately fine punctuation; lateral scutum smooth, with sparse irregularly scattered punctuation; notauli well defined as crenulate furrow; scutellum broad and flat, not as rounded as in other species, punctate, no lateral spines defined; dorsellum only slightly prominent, not emarginate; mesopleuron punctate to punctate-reticulate; mesosternum smooth with sparse moderately fine punctuation; propodeum $0.47\text{--}0.6 \times$ as long as wide, punctate-reticulate, medial longitudinal furrow present, with moderately long fine pilosity laterally, postero-lateral area square; indentation about nucha absent.

Wings

Lightly infusate, with short fine setae; stigmal spot defined as opaque buff-coloured area, with stigmal vein very lightly infusate poorly defined.

Metasoma

$2.43\text{--}2.56 \times$ as long as wide, with moderately long fine pilosity; T1 $0.7\text{--}0.81 \times$ as long as upper anterior width, $0.65\text{--}0.72 \times$ as long as lower anterior width, strigose-reticulate; T2 longitudinally strigose; T3–T5 longitudinally strigose, with smooth medial patch; T6 rugose-reticulate; S1 rugose-reticulate; S2 longitudinally strigose, with basal transverse ridge and furrow; S3–S5 longitudinally strigose laterally, smooth medially; S2–S3 without felt lines or nodes defined.

Male

Unknown.

Distribution

Scelio planithorax is known from coastal southern Queensland and New South Wales (Fig. 8.199).

Host

Gastrimargus musicus. (see Tables 4.2 and 4.3).

Comments

In the phylogenetic analysis *S. planithorax* is the sister species of *S. ignobilis* although they share no unequivocal character states (Fig. 6.2). They can be distinguished in that *S. planithorax* has a reduced dorsal occipital carina, the vertex with coarse punctuation, the latero-ventral corners of the propodeum rounded, and S2 felt fields apparently absent. Males for this species are inferred from the phylogenetic analysis as lacking antennal tyloids. The species is distinctive because of its flattened dorsal scutellum, lack of reticulate punctuation on the scutum and scutellum, long punctate-reticulate propodeum, and long apically broad metasoma.

SCELIO PSEUDAUSTRALIS DANGERFIELD & AUSTIN SP. NOV.

(Fig. 8.200)

Material examined

Holotype

♀, Queensland, 'L. Broadwater, via Dalby, Qld. 19–22.xi.1985 D-vac' (ANIC).

Paratypes

Queensland: 2 ♀, same data as holotype (ANIC).

Female*Length*

3.3–3.4 mm (mean 3.35 mm).

Colour

Brown except legs, scape, pedicel and mandibles yellow.

Head

Width between eyes $0.57 \times$ width of head in dorsal view; OOL 0.03 mm; LOL 0.23 mm; POL 0.27 mm; ocellar diameter 0.05 mm, $0.13 \times$ width between eyes; head with moderately coarse and translucent pilosity; occiput virtually smooth medially, reticulate at edges; posterior vertex rugose-reticulate; medial vertex rugulose to rugose-reticulate; dorsal frons rugose-reticulate; malar region with radiating striae, continuing past level of interantennal process, becoming reticulate on dorsal frons; malar space $0.59 \times$ as long as eye height; interantennal process short, narrow, with prominent lateral carinae continuing around antennal socket; clypeus produced and convex between lateral points; anteclypeus narrowly defined by raised smooth area; mandibles smooth, lower tooth $0.75 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Dorsal pronotum with faint longitudinal striae; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum rugose-reticulate; pronotal shoulders prominent, defined by carinae; scutum rugose-reticulate; notauli poorly defined amongst sculpturing; scutellum rugose-reticulate, no lateral spines defined; dorsellum moderately prominent, not emarginate; mesopleuron punctate anteriorly to rugose-reticulate posteriorly; mesosternum punctate to punctate-reticulate; propodeum $0.44 \times$ as long as wide, reticulate-rugose laterally about carinae defining medial longitudinal furrow, with short white pilosity laterally, postero-lateral area square; indentation about nucha deep.

Wings

Lightly infusate, with short fine setae; stigmal spot defined as elongate translucent swelling, with stigmal vein.

Metasoma

$2.8 \times$ as long as wide, pilosity moderately fine basally, becoming coarser towards apex; T1 $0.88 \times$ as long as upper anterior width, $0.79 \times$ as long as lower anterior width, longitudinally striate; T2 longitudinally striate, becoming weaker medio-posteriorly; T3–T4 virtually smooth medially, becoming reticulate to striate-reticulate laterally; T5 longitudinally striate; T6 foveolate; S1–S2 longitudinally strigose, S3–S5 smooth medially, reticulate-striate laterally; S2 with basal transverse ridge and felt nodes; S3 with felt nodes defined.

Male

Unknown.

Distribution

Scelio pseudaustralis is only known from Lake Broadwater in south-eastern Queensland (Fig. 8.200).

Host

Unknown.

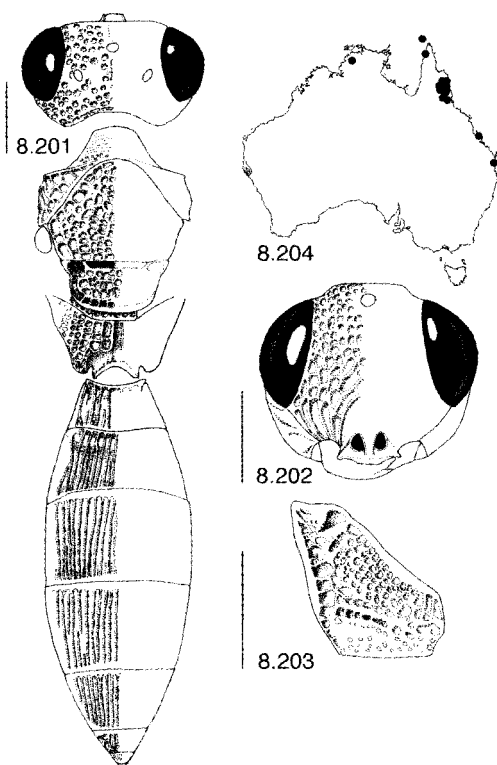
Comments

This species is rather distinctive and can be separated from other Australian *Scelio* by its small size, elongate and somewhat delicate body, coarse pilosity, smooth patches on T3 and T4, and uniformly lightly infusate wings. It is named after its similarity to *S. australis*, a taxon thought to be valid for the last 90 years but which is now a junior synonym of *S. gobar*. Its phylogenetic relations are discussed under *S. gobar*.

SCELIO PUNCTATICEPS DODD

(Figs 8.201–8.204)

Scelio punctaticeps Dodd, 1914a: 77; Dodd, 1914b: 119; Tillyard, 1926: 283; Kieffer, 1926: 340; Dodd, 1927: 171; Galloway & Austin, 1984: 11; Johnson, 1992: 487.



Figs 8.201–8.204. *Scelio punctaticeps* Dodd: 8.201. ♀ Holotype, dorsal habitus. 8.202. ♀ Holotype, anterior head. 8.203. ♀, mesopleuron. 8.204. Distribution map. Scale lines: 0.25 mm.

Material examined

Holotype

♀, Queensland, 'Cairns' (SAMA) (antennae and wings on a slide); as per description Dodd (1914), Nelson near Cairns, 3 May 1913, A.A. Girault.

Other material examined

Queensland: 1 ♀, 3 km W Batavia Downs, 12.40S, 142.39E, 11 Dec. 1992–16 Jan. 1993, P. Zborowski (ANIC); 1 ♀, Buderim, 22 Mar.–3 Apr. 1985, G. K. Waite (ASCU); 18 ♀,

Gordonvale, Jan. Sep. Oct. 1920, no collector (15 ANIC, 3 ASCU); 2 ♀, Kuranda, Mar. 1921, no collector (ANIC); 1 ♀, Little Mitchell River near Yalkula, 28 Mar. 1976, I.D. Galloway (ASCU); 1 ♀, Mossman, Apr. 1926, no collector (ASCU); 1 ♀, 5 km N Mt Molloy, 21 Apr. 1974, J.F. Donaldson (WINC); 1 ♀, Prince of Wales Island, Torres Strait, 27–30 May 1969, Neboiss (ASCU); 1 ♀, Tully Falls Road, 31 Mar. 1976, I.D. Galloway (ASCU); 1 ♀, Wongabel S.F., 6 km S Atherton, 10 Feb.–13 Mar. 1984, no collector (ASCU); 1 ♀, 23 km N Yeppoon, 31 Oct. 1975, I.D. Galloway (WINC). **Northern Territory:** 1 ♀, Coorralie Creek, left branch on Batchelor Road off Stuart Highway, 30 Dec. 1979, M. Malipatil (ASCU).

Female

Length

2.8–4.1 mm (mean 4.0 mm).

Colour

Brown except legs, mandibles, scape and pedicel yellow.

Head

Width between eyes $0.51\text{--}0.52 \times$ width of head in dorsal view; OOL $0.06\text{--}0.07$ mm; LOL $0.18\text{--}0.19$ mm; POL $0.28\text{--}0.34$ mm; ocellar diameter $0.07\text{--}0.08$ mm, $0.13\text{--}0.16 \times$ width between eyes; head with fine translucent pilosity; occiput irregularly punctate; posterior vertex coarsely punctate; medial vertex and dorsal frons punctate; ventral frons punctate-reticulate; malar region with short radiating strigosity, continuing to interantennal process or ventral eye margin then becoming punctate-reticulate; malar space $0.41\text{--}0.43 \times$ as long as eye height; interantennal process moderately narrow, with lateral carinae continuing around antennal sockets; clypeus moderately produced between lateral points, with medial margin convex; anteclypeus defined by raised smooth marginal area; mandibles smooth, lower tooth $0.6\text{--}0.83 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity moderately long, fine, translucent; dorsal pronotum rugulose anteriorly, finely punctate posteriorly; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum smooth anteriorly, becoming punctate-reticulate posteriorly; pronotal shoulders prominent, defined by transverse carina; scutum punctate-reticulate; notauli not defined amongst sculpturing of scutum; scutellum punctate-reticulate, no lateral spines defined; dorsellum broad, only very slightly raised above level of rest of metanotum, not emarginate; mesopleuron punctate to punctate-reticulate; mesosternum punctate; propodeum $0.6\text{--}0.65 \times$ as long as wide, punctate-reticulate, becoming finer laterally, medial longitudinal furrow present in anterior half, with dense moderately long fine white pilosity laterally, postero-lateral area narrowed and rounded; indentation about nucha present.

Wings

Lightly infusate, with short fine setae; light-coloured stigmal spot defined, with faintly infusate stigmal vein.

Metasoma

$2.41\text{--}2.85 \times$ as long as wide, with fine pilosity; T1 $0.84\text{--}0.95 \times$ as long as upper anterior width, $0.68\text{--}0.9 \times$ as long as lower anterior width; T1–T5 longitudinally striate to strigose; T6 punctate-reticulate; S1–S5 longitudinally strigose, with scattered fine background punctation, S2 with basal transverse ridge; S2–S3 without felt lines or nodes defined.

Male

Unknown.

Distribution

Scelio punctaticeps is known from coastal Queensland and the Northern Territory (Fig. 8.204).

Host

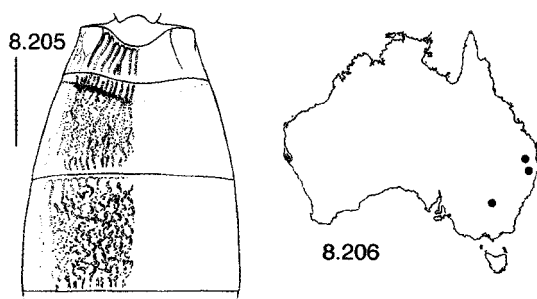
Unknown.

Comments

In the phylogenetic analysis *S. punctaticeps* comes out as the sister species of *S. fulgidus* + *S. erythropus* + *S. petilus* although they share no unequivocal character states. *Scelio punctaticeps* can be distinguished from these species by the reticulate malar region and the densely sculptured mesosternum. Males for this species are inferred from the phylogenetic analysis as having antennal tyloids. *Scelio nigricoxa* Dodd, known only from two male specimens, may be the male of this species or *S. striatifacies* (see discussion under *S. nigricoxa*).

SCELIO RETICULATUM DANGERFIELD & AUSTIN SP. NOV.

(Figs 8.205, 8.206)



Figs 8.205, 8.206. *Scelio reticulatum* sp. nov.: 8.205. ♀ Holotype, dorsal T1 to T3. 8.206. Distribution map. Scale line: 0.25 mm.

Material examined

Holotype

♀, New South Wales, 'Yanco 8 Nov 49 E F Riek' 34.36S, 146.26E (ANIC).

Paratype

Queensland: 1 ♀, Chinchilla, Mar. 1927, B.A. Smith (ANIC). **New South Wales:** 1 ♀, same data as holotype (ANIC); 1 ♀, Gravesend, Apr. 1928, H.T. Nicholas (ANIC).

Female

Length

4.5 mm.

Colour

Head black; pronotum, scutum, propodeum and trochanter to tibiae yellow-orange; antennae, coxae, mesopleuron, mesosternum, scutellum, metanotum and metasoma light to medium brown.

Head

Width between eyes 0.48–0.49 × width of head in dorsal view; OOL 0.01–0.02 mm; LOL 0.26 mm; POL 0.4 mm; ocellar diameter 0.06 mm, 0.13 × width between eyes; head with

fine sparse pilosity, slightly coarser on face and temples; occiput strigose; posterior vertex sparsely rugulose-reticulate; medial vertex punctate between faint transverse reticulation; frons punctate; malar region punctate to punctate-reticulate; malar space $0.78\text{--}0.8 \times$ as long as eye height; interantennal process short, broad, with lateral carinae continuing around antennal sockets; clypeus narrowly produced and convex between lateral points; anteclypeus defined by broad raised smooth area; mandibles smooth, lower tooth $0.77\text{--}1.0 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity moderately coarse on lateral pronotum, otherwise fine and sparse; dorsal pronotum virtually smooth; latero-dorsal pronotum virtually smooth, with faint indication of rugulosity; latero-ventral pronotum smooth anteriorly, becoming striate-reticulate at posterior margin; pronotal shoulders moderately prominent, defined by transverse carina; anterior and lateral scutum smooth, with sparse scattered broad punctures, posterior scutum faintly punctate-reticulate; crenulate notauli defined in posterior half; scutellum rugose-reticulate medially, becoming broadly punctate laterally, no lateral spines defined; dorsellum prominent, slightly emarginate, with producing dorso-lateral points; mesopleuron distinctly striate; mesosternum mostly smooth, with sparse scattered punctation; propodeum $0.4\text{--}0.42 \times$ as long as wide, rugulose about longitudinal carinae defining medial longitudinal furrow, with sparse fine long pilosity laterally, postero-lateral area square to rounded; indentation about nucha broad.

Wings

Lightly infusate, with fine short setae; light-coloured stigmal spot defined, without stigmal vein.

Metasoma

$2.38\text{--}2.5 \times$ as long as wide, with very short fine sparse pilosity; T1 $0.54\text{--}0.58 \times$ as long as upper anterior width, $0.34\text{--}0.35 \times$ as long as lower anterior width, longitudinally strigose-reticulate; T2–T5 finely rugulose-reticulate; T6 rugulose with foveolae; S1–S5 finely rugulose-reticulate; S2 with basal transverse ridge; S2–S3 without felt lines or nodes defined.

Male

Unknown.

Distribution

Scelio reticulatum is known from Yanco, central-southern New South Wales to Chinchilla, southern Queensland (Fig. 8.206).

Host

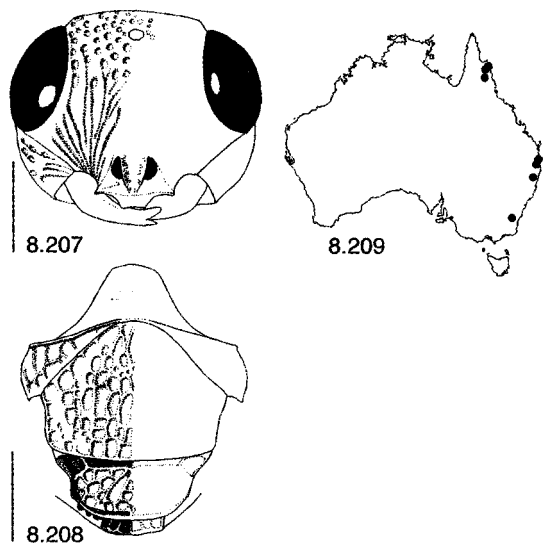
Unknown.

Comments

Scelio reticulatum is the sister species of *S. semisanguineus*, although they share no unequivocal character states. They can be distinguished by *S. reticulatum* having the latero-ventral pronotum smooth anteriorly, the mesopleuron striate to strigate medially, and the dorsellum prominent and slightly emarginate. Males for this species are inferred from the phylogenetic analysis as lacking antennal tyloids. It is named after the distinct finely reticulate sculpturing on the metasomal tergites.

SCELIO SCHMELIO DANGERFIELD & AUSTIN SP. NOV.

(Figs 8.207–8.209)



Figs 8.207–8.209. *Scelio schmelio* sp. nov.: 8.207. ♀, anterior head. 8.208. ♀, dorsal pronotum to metanotum. 8.209. Distribution map. Scale lines: 0.25 mm.

Material examined

Holotype

♀, Queensland, '15.39S 144.31E Split Rock QLD 13 Dc1992–18Fb1993 P. Zborowski Malaise Trap' (ANIC).

Paratypes

Queensland: 1 ♀, 7.5 km on rd to Granite Gorge nr Mt Aunt, Atherton Tablelands, 2 May 1988, E.C. Dahms, G. Sarnes (QMBA); 1 ♀, 13 km NE Dunwich, North Stradbroke Island, 27.27S, 153.29E, 16 Feb. 1991, G. Daniels (UQIC); 1 ♀, 5 km WSW Point Lookout, North Stradbroke Island, 27.26S, 153.30E, 27 Mar. 1993, G. Daniels, C.J. Burwell (UQIC); 1 ♀, 1 km N of Rounded Hill, 5–7 May 1981, I.D. Naumann (ANIC); 2 ♀, Split Rock, 15.39S, 144.31E, 30 Oct.–24 Nov. 1992, P. Zborowski, A. Calder, M.T. (ANIC). **New South Wales:** 1 ♀, Styx River State Park, Falls Rd, 22 km SE Wollomombi, 15 Dec. 1993–2 Feb. 1994, K. MacGregor, F.I.T. (CNCI); 1 ♀, Donaldson State Forest via Woodenbong, 30 Dec. 1979, I.D. Naumann (ANIC). **Australian Capital Territory:** 1 ♀, Blundells Creek, 35.22S, 148.50E, Feb. 1987, D.H. Colless, M.T. (ANIC).

Female

Length

4.0–4.6 mm (mean 4.4 mm).

Colour

Head black; mesosoma excluding scutellum, dorsellum, toruli, scape and pedicel orange; mandibles, scutellum, dorsellum and metasoma brown.

Head

Width between eyes 0.52–0.54 × width of head in dorsal view; OOL 0.03–0.04 mm; LOL 0.3 mm; POL 0.45 mm; ocellar diameter 0.08–0.09 mm, 0.13 × width between eyes; head

with fine short translucent pilosity; occiput finely punctate; posterior vertex punctate-reticulate; medial vertex punctate; dorsal frons punctate; malar region with radiating striae, continuing halfway up frons but not meeting medially above speculum; malar space $0.54\text{--}0.6 \times$ as long as eye height; interantennal process short, with well-developed lateral carinae continuing around antennal sockets; clypeus well produced between lateral points, medial margin straight to slightly concave; anteclypeus broadly defined by smooth area; mandibles smooth, lower tooth $0.5\text{--}0.6 \times$ upper tooth, dorsal tooth absent

Mesosoma

Pilosity moderately coarse, stout, translucent, finer on dorsal pronotum; dorsal pronotum with faint transverse striae; latero-dorsal pronotum faintly rugose-reticulate; latero-ventral pronotum smooth anteriorly, rugose at posterior margin; pronotal shoulders prominent, defined by transverse carina; scutum rugose-reticulate medially to punctate-reticulate laterally; notauli not defined amongst sculpturing; scutellum punctate-reticulate, no lateral spines defined; dorsellum prominent well raised, not emarginate; mesopleuron smooth medially, strigose dorsally, punctate-reticulate laterally; mesosternum punctate to punctate-reticulate; propodeum short, $0.28\text{--}0.34 \times$ as long as wide, rugose-reticulate with arched posterior carina, medial longitudinal furrow present anteriorly, with fine moderately sparse pilosity throughout, postero-lateral area rounded; indentation about nucha narrow.

Wings

Lightly infusate, darker in apical half, with fine moderately long setae; light brown stigmal spot defined, without stigmal vein.

Metasoma

$2.0\text{--}2.05 \times$ as long as wide, with fine sparse lateral pilosity; T1 $0.61\text{--}0.63 \times$ as long as upper anterior width, $0.43 \times$ as long as lower anterior width, longitudinally strigose; T2 faint longitudinal striations, smoother medially; T3–T4 faintly rugulose medially, strigose laterally; T5 longitudinally striate; T6 punctate-reticulate; S1–S2 rugose-reticulate; S3–S5 faintly strigose, smoother medially; S2 with shallow basal transverse ridge; S2–S3 with indistinct felt nodes defined.

Male

Unknown.

Distribution

Scelio schmelio is known from eastern Australia from north Queensland to the Australian Capital Territory (Fig. 8.209).

Host

Unknown.

Comments

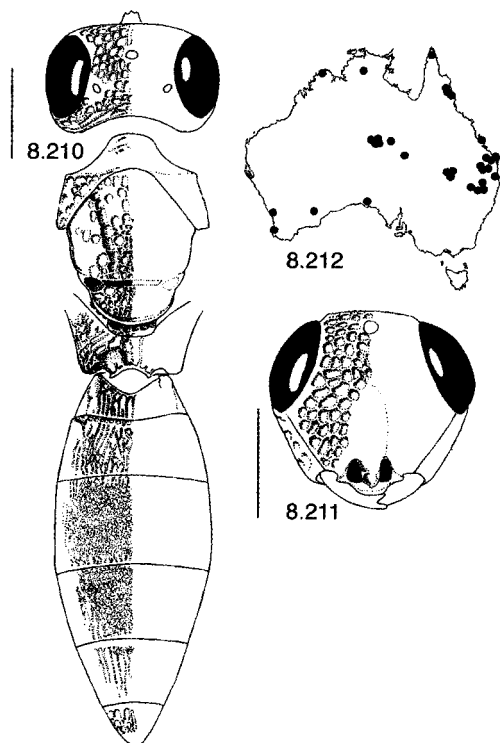
Scelio schmelio can be readily separated from other Australian species by its emarginate dorsellum, contrasting orange and black mesosoma, darkly infusate wings, and sculpturing type on the malar region and metasoma. It is the sister species of *S. notabilis* + *S. mareebaensis* + *S. zborowskii* although they share no unequivocal character states. This species was named in a moment of despair when trying to think up new names for the large number of species described as part of this study – this particular name rhymed and was easy to remember.

SCELIO SEMISANGUINEUS GIRAULT STAT. REV.

(Figs 8.210–8.212)

Scelio semisanguineus Girault 1914: 197; Dodd, 1914b: 110; Kieffer, 1926: 337; Dodd, 1927: 151 (synonymised with *S. nigricornis* Dodd); Galloway, 1976: 105. **Stat. rev.**

Scelio semisanguineus nigrocinctus Dodd, 1920: 346; Dodd, 1927: 151 (synonymised with *S. nigricornis* Dodd); Masner 1965: 94; Galloway, 1976: 105. **Syn. nov.**



Figs 8.210–8.212. *Scelio semisanguineus* Girault: 8.210. ♀ Holotype, dorsal habitus. 8.211. ♀ Holotype, anterior head. 8.212. Distribution map. Scale lines: 0.25 mm.

Material examined

Lectotype

♀ (*Scelio semisanguineus* Girault), no data label (QMBA). The most apical specimen of the five syntypes mounted together is here designated as the lectotype. ♀ (*Scelio semisanguineus nigrocinctus* Dodd), 'S.W. Australia. Yallingup 1–12 Dec. 1913' 'R.E. Turner 1914–190' (BMNH).

Paralectotypes

4 ♀, mounted, together with the lectotype are here designated as paralectotypes (QMBA).

Other material examined

Queensland: 2 ♀, Alley Creek, 0.5 km W Gordonvale, 20 Apr. 1987, E.C. Dahms, G. Sarnes (QMBA); 1 ♀, Bribie Island, 28 Dec. 1976, Boucek (WINC); 1 ♀, Biggenden, no date, A.P. Dodd (ANIC); 5 ♀, Brisbane, Feb. 1917, no collector (ANIC); 1 ♀, Carr Creek, 18 km NNW Mareeba, 21 May 1980, I.D. Naumann, J.C. Cardale, (ANIC); 15 ♀, Chinchilla, 15 Jan. 1927, Feb. 1929, A.P. Dodd (ANIC); 9 ♀, Chinchilla, Mar. 1927, B.A. Smith (ANIC); 1 ♀, Eidsvold, 25.22S, 151.07E, 11 Oct. 1984, I. Naumann, J. Cardale (ANIC); 3 ♀, Goondiwindi, Oct. 1930, A.P. Dodd, Dec. 1925, A.R. Taylor (ANIC); 6 ♀, Gordonvale, Jan. 1920 (ANIC);

1 ♀, Heathlands, 11.45S, 142.35E, 15–26 Jan. 1992, I. Naumann, T. Weir (ANIC); 4 ♀, Kingaroy, 16 Apr. 1927, A.P. Dodd (ANIC); 2 ♀, Kuranda, Dec. 1927, A.P. Dodd (ANIC); 2 ♀, nr. L. Muncoonie NW Birdsville, 12–16 Nov. 197 R. Raven, ex pitfall trap desert area (ANIC); 1 ♀, Malanda, Apr. 1921, no collector (ASCU); 1 ♀, Mareeba, 31 Jul.–7 Aug. 1992, D.H. Habeck MT (CNCI); 1 ♀, Miles, 26 Jan. 1924, no collector (ANIC); 1 ♀, Mossman, Apr. 1920, no collector (ANIC); 1 ♀, Mt Tambourine, 28 Dec. 1966, J.H. Barrett (WINC); 1 ♀, Westwood, Oct. 1927, A.P. Dodd (ANIC). **New South Wales:** 3 ♀, Gravesend, 30 Apr. 1927, Apr. 1928, H.T. Nicholas, A.P. Dodd (ANIC); 1 ♀, Mooni Riv. Oct. 1926, A.P. Dodd (ANIC); 1 ♀, Moree, Jan. 1926, A.P. Dodd (ANIC). **South Australia:** 1 ♀, 10 km WNW Penong, 31.53S, 132.54E, 14 Oct. 1981, I.D. Naumann, J.C. Cardale (ANIC). **Western Australia:** 1 ♀, 59 km EbyN Balladonia RH, 12 Oct. 1981, I.D. Naumann, J.C. Cardale (ANIC); 1 ♀, 12 km S Kulumburu Mission, 14.25S, 126.38E, CALM site 13/4. 6–11 Jun. 1988, T.A. Weir (ANIC); 3 ♀, Perth, 14 Nov. 1982, Z. Boucek (2, BMNH; 1, WINC). **Northern Territory:** 1 ♀, 39 km E Alice Springs, 23.47S, 134.15E, 5 Oct. 1978, J.C. Cardale (ANIC); 1 ♀, 53 km EbyN Alice Springs, 23.35S, 134.22E, 6 Oct. 1978, J.C. Cardale (ANIC); 1 ♀, 32 km WNW Alice Springs, 23.36S, 133.35E, 8 Oct. 1978, J.C. Cardale (ANIC); 1 ♀, Plenty River, 245 km ENE Alice Springs, 23.00S, 136.08E, 14 Oct. 1978, J.C. Cardale (ANIC); 1 ♀, 1 km SWbyW Corroboree Rock, 23.39S, 134.14E, 21 May 1978, J.C. Cardale (ANIC); 1 ♀, Katherine, 13 Mar. 1979, no collector, ex Mungbean (ASCU).

Female

Length

3.3–3.8 mm (mean 3.6 mm).

Colour

The holotype and some specimens (labelled A group) have the head black, apical antenna mid brown, metasoma light brown and the rest of the body orange. Other specimens vary in the melanisation of the mesosoma and metasoma and these can be divide into three distinct groups (labelled B–D): B group has the pronotum, scutum, scutellum and metanotum mid brown and the propodeum and metasoma orange; C group has the pronotum, scutum and scutellum dark to mid brown and the propodeum and metasoma mid to light brown; D group has the body dark brown with medio-dorsal metasoma light brown.

Head

Width between eyes $0.46\text{--}0.5 \times$ width of head in dorsal view; OOL 0.02 mm; LOL 0.17–0.21 mm; POL 0.28–0.31 mm; ocellar diameter 0.05–0.06 mm, $0.13\text{--}0.15 \times$ width between eyes; head with coarse stout pointed pilosity, becoming coarser on temples and ventral frons; occiput rugulose; posterior vertex with irregular transverse carinae, becoming punctate-reticulate anteriorly; medial vertex punctate-reticulate; dorsal frons punctate; malar region punctate-to punctate-reticulate; malar space $0.65\text{--}0.75 \times$ as long as eye height; interantennal process strongly narrowed ventrally, with lateral carina continuing around antennal sockets, not onto frons; clypeus moderately produced and convex between lateral points; anteclypeus poorly defined by raised smooth marginal area; mandibles smooth, lower tooth $1.0 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity coarse, stout, pointed, becoming coarser on lateral pronotum; dorsal pronotum irregularly rugulose; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum transversely strigose; pronotal shoulders prominent, defined by transverse carina; anterior scutum with moderately coarse reticulate punctures; posterior scutum coarsely punctate-reticulate laterally, becoming finer medially; lateral scutum smooth, with scattered large punctures to punctate-reticulate; notauli poorly to moderately well defined; scutellum

punctate-reticulate, no lateral spines defined; dorsellum slightly to moderately prominent, not emarginate; mesopleuron transversely striate to strigose; mesosternum smooth medially with lateral fine punctation; propodeum $0.41\text{--}0.51 \times$ as long as wide, rugose-reticulate to finely rugulose-reticulate laterally about broad medial longitudinal furrow, with fine moderately dense pilosity laterally, postero-lateral area square to rounded; indentation about nucha present.

Wings

Lightly infusate, with fine short setae; stigmal spot poorly defined and translucent, with short spectral stigmal vein.

Metasoma

$2.0\text{--}2.85 \times$ as long as wide, with fine pilosity laterally; T1 $0.43\text{--}0.48 \times$ as long as upper anterior width, $0.30\text{--}0.38 \times$ as long as lower anterior width, longitudinally strigose; T2 strigose anteriorly, becoming reticulate posteriorly; T3–T4 with moderately fine reticulation, T5 longitudinally strigose; T6 punctate-reticulate; S1–S5 with moderately fine reticulation, S2 with shallow transverse basal ridge; S2–S3 without felt lines or nodes defined.

Male

Unknown.

Distribution

Scelio semisanguineus is widely distributed across mainland Australia but apparently does not occur in the south-east (Fig. 8.212).

Host

Unknown.

Comments

Scelio semisanguineus, originally described only for the female sex, was synonymised with *S. nigricornis* by Dodd (1927), the latter known only from a male holotype. However, the types of these species are distinctly different and there is no evidence to support their association. *Scelio semisanguineus* has therefore been reinstated as a valid species. It can be distinguished by the dimensions of the metasoma and T1, the fine reticulation on T3, and the coarse pilosity on the head and mesosoma.

Several groups can be distinguished within this species based on colour differences and variation in the dimensions of the metasoma. These differences may indicate the presence of cryptic species but, until populations can be examined in more detail, the nature of this variation will remain unknown. The phylogenetic relationships are discussed under *S. reticulatum*. Males for this species are inferred from the phylogenetic analysis as lacking antennal tyloids.

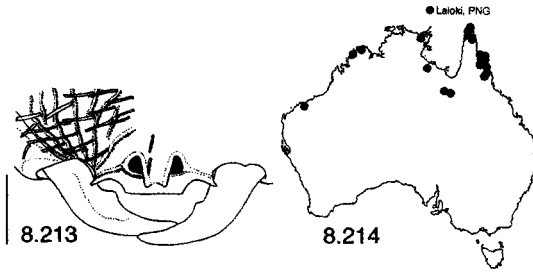
SCELIO SETAFASCIS DANGERFIELD & AUSTIN SP. NOV.

(Figs 8.213, 8.214)

Material examined

Holotype

♀, Queensland, '15.01S, 145.07E, 3.5 Km SWbyS of Mt. Baird Q 3–5 May 1981 I.D. Naumann ex ethanol' (ANIC).



Figs 8.213, 8.214. *Scelio setafascis* sp. nov.:
8.213. ♀, lower anterior head, showing straight clypeal margin and coarse setae.
8.214. Distribution map. Scale line: 0.25 mm.

Paratypes

Queensland: 3 ♀, same data as holotype (ANIC); 1 ♀, Amphitheatre Springs, 28 km NE Musselbrook Camp, 18.21S, 138.11E, 12 May, I.D. Naumann (ANIC); 1 ♀, Biffin Swamp, S Bamaga, 10 Sep. 1983, J.F. Donaldson (QDPC); 1 ♀, nr Bowerbird Creek, 9 km W Mount Molloy, 16.40S, 145.15E, 23 Apr. 1997, C.J. Burwell (QMBA); 1 ♀, Bull Creek, 15.18S, 144.49E, 27 Jun. 1993, I.D. Naumann, P. Zborowski (ANIC); 1 ♀, 2 km S Cape York, 10.43S, 142.32E, 29 Jun. 1993, I.D. Naumann, P. Zborowski, open forest (ANIC); 2 ♀, Cockatoo Creek Crossing, 17 km NW Heathlands, 11.39S, 142.27E, 19 Jan. & 26 Jan.–29 Feb., P. Feehney, M.T. (ANIC); 1 ♀, Davise Creek National Park, 10 km E Mareeba, 18 Feb. 1984, L. Masner (CNCI); 2 ♀, 1 ♂, Heathlands, 11.45S, 142.35E, 15–26 Jan. 1992, I. Naumann, T. Weir (ANIC); 3 ♀, 14 km WhyN Hope Vale Mission, 15.16S, 144.59E, 7–20 May 1981 & 8–10 Oct. 1980, I.D. Naumann (ANIC); 2 ♀, 15 km NE Mareeba, 7 Jan. 1985, Storey, Titmarsh (QDPC); 1 ♀, Mareeba, 17–21 Jun. 1992, D.H. Habeck (CNCI); 1 ♀, Millstream Falls National Park, 17.41S, 145.26E, 24–25 May 1980, I.D. Naumann, J.C. Cardale (ANIC); 1 ♀, 6 km S Mount Molloy, 30 Jan. 1982, J.F. Donaldson (QDPC); 2 ♀, Murray's Spring, 7 km W Musselbrook Resource Centre, Lawn Hill NP, 18.35S, 138.04E, 24 Apr. 1995, G. Daniels, M.A. Schneider (UQIC); 1 ♀, 1 km N Rounded Hill, 5–7 May 1981, I.D. Naumann (ANIC); 1 ♀, Ridgepole Waterhole, 24 km ESE Musselbrook Camp, 18.04S, 138.20E, 11 May 1995, I.D. Naumann (ANIC); 2 ♀, Ridgepole Waterhole, 24 km ESE Musselbrook Camp, 18.40S, 138.22E, 23 Apr. 1995, G. Daniels, M.A. Schneider (UQIC); 1 ♀, Southedge, 11 km NW Mareeba, 28 Dec. 1986, H. & A. Howden, F.I.T. (ANIC); 1 ♀, Split Rock, 15.39S, 144.31E, 13 Dec. 1992–18 Feb. 1993, P. Zborowski, M.T. (ANIC). **Western Australia:** 1 ♀, CALM site 13/4, 12 km S, Kalumburu Mission, 14.25S, 126.38E, 7–11 Jun. 1988, T. Weir (ANIC); 1 ♀, Millstream, 24 Oct. 1970, J.C. Cardale (ANIC); 2 ♀, Mining Camp Mitchell Plateau, 14.49 S, 125.05E, 9–19 May 1983, I.D. Naumann, J.C. Cardale, M.T. (ANIC). **Northern Territory:** 1 ♀, McArthur River, 2 km SSE Borroloola, 16.05S, 136.19E, 20 Apr. 1976, D.H. Colless (ANIC); 1 ♀, Ngarradj Warde Djokkeng, Kakadu National Park, 12.27S, 135.55E, 27 Jun. 1980, I.D. Naumann (ANIC). **Papua New Guinea:** 1 ♀, Laloki CSIRO Screw Worm Lab. Apr. 1987, S. Bakker, F.I.T. (ANIC).

Female

Length

3.8–4.3 mm (mean 4.0 mm).

Colour

Dark brown except legs and palps yellow, antennal toruli, scape, pedicel and mandibles light brown.

Head

Width between eyes 0.55–0.56 × width of head in dorsal view; OOL 0.03 mm; LOL 0.33 mm; POL 0.54 mm; ocellar diameter 0.06 mm, 0.09–0.1 × width between eyes; head

with very coarse long blunt-tipped white opaque pilosity, becoming finer and tan coloured on medial vertex; occiput finely punctate to strigose; posterior vertex rugose-reticulate; medial vertex rugose-reticulate; dorsal frons rugose-reticulate with longitudinal trend; malar region with well-defined radiating striae, continuing halfway up frons, not meeting above speculum, becoming reticulate dorsally; malar space $0.55 \times$ as long as eye height; interantennal process short, narrow and deep, with lateral carinae continuing around antennal sockets; clypeus produced between lateral points, medial margin with broad straight edge; anteclypeus defined by raised smooth area; mandibles smooth, lower tooth $0.78\text{--}0.92 \times$ upper tooth, dorsal tooth present.

Mesosoma

Covered with very coarse long blunt-tipped white opaque pilosity, becoming finer and tan coloured on posterior scutum and scutellum; dorsal pronotum finely punctate, with faint transverse striae; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum virtually smooth anteriorly, becoming rugose-reticulate posteriorly; pronotal shoulders prominent, defined by transverse carina; scutum rugose-reticulate; notauli not defined amongst sculpturing; scutellum rugose-reticulate with longitudinal trend, no lateral spines defined; dorsellum prominent broad, not emarginate; mesopleuron rugulose to punctate-reticulate; mesosternum rugose-reticulate; propodeum $0.44\text{--}0.5 \times$ as long as wide, rugose-reticulate, medial longitudinal furrow absent, covered in a mixture coarse white opaque and fine translucent pilosity laterally, postero-lateral area rounded; indentation about nucha absent.

Wings

Lightly infusate in basal third, moderately dark in apical two-thirds, with moderately long coarse setae; small round dark stigmal spot defined, with stigmal vein.

Metasoma

$2.17\text{--}2.3 \times$ as long as wide; T1–T4 with coarse white opaque pilosity in antero-lateral patches, glabrous medially, T5 with same throughout, T6 with slightly finer tan-coloured pilosity throughout; T1 $0.73\text{--}0.76 \times$ as long as upper anterior width, $0.64\text{--}0.73 \times$ as long as lower anterior width, longitudinally strigose; T2 longitudinally striate, becoming fainter medially; T3 longitudinally strigose with background reticulation; T4 longitudinally striate, with medial smooth patch, T5 longitudinally striate; T6 rugose; S1–S6 strigose-reticulate with longitudinal trend; S2 with basal transverse ridge and pronounced felt node; S3 with broad felt field defined with fine pilosity.

Male

As for female except pilosity slightly finer; wings not as darkly infusate in apical two-thirds; antenna without clearly defined tyloids; femora slightly swollen medially; clypeal margin convex medially.

Distribution

Scelio setafascis is distributed across northern coastal Australia and into Papua New Guinea (Fig. 8.214).

Host

Unknown.

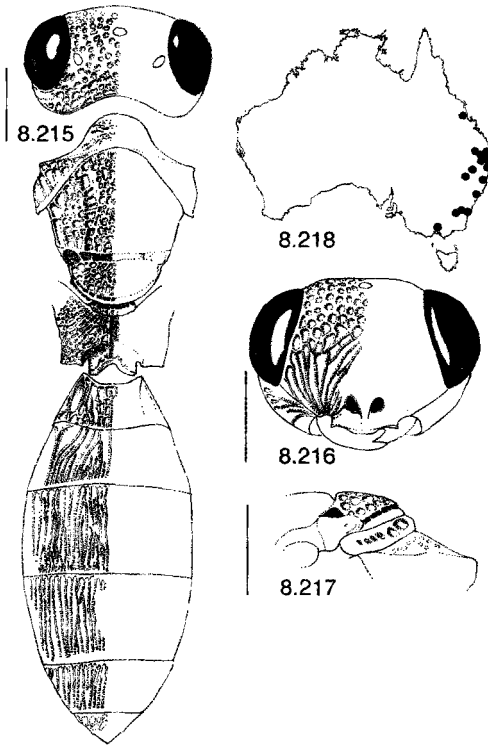
Comments

The relationships of *S. setafascis* are discussed under *S. borrooloolensis*. It is similar to *S. flavicornis* known only from males, but can be distinguished by the yellow coxae. It is named after the Latin 'seta' meaning 'bristle' and 'fascis' meaning 'bundle', and relates to the grouped coarse setae on the metasoma.

***SCELIO STRIATIFACIES* DODD**

(Figs 8.215–8.218)

Scelio striatifacies Dodd, 1914b: 115.- Kieffer, 1926: 340; Dodd, 1927: 169; Galloway, 1976: 106; Galloway & Austin, 1984: 11; Johnson, 1992: 489.



Figs 8.215–8.218. *Scelio striatifacies* Dodd: 8.215. ♀ Holotype, dorsal habitus. 8.216. ♀ Holotype, anterior head. 8.217. ♀ Holotype, lateral scutellum and metanotum. 8.218. Distribution map. Scale lines: 0.25 mm.

Material examined*Holotype*

♀, New South Wales, (no data label on specimen) but New South Wales, Harwood, Clarence River, Dodd (1914c), antennae and fore wings slide mounted (SAMA).

Other material examined

Queensland: 1 ♀, Lake Broadwater via Dalby, 19–22 Nov. 1985, no collector (ASCU); 1 ♀, Bunya Mts, 26.51S, 151.34E, 20–24 Apr. 1986, B.K. Cantrell (ASCU); 4 ♀, Chinchilla, Nov. 1926, 15 Jan. 1931, A.P. Dodd (ANIC); 3 ♀, Gatton, DPI Research Station, 24 Apr. 1970, 21–27 Apr. 1981, G.K. Waite, ex Lucerne (WINC); 1 ♀, Indooroopilly, 10–17 Dec. 1984, no collector (ASCU); 1 ♀, Mooloolah, no date, A.P. Dodd (ANIC); 1 ♀, Mt Abbott, 20.06S, 147.45E, 7 Dec. 1996–9, Apr. 1997, Monteith, Cook (QMBA); 1 ♀, Mt Glorious, 28 Feb.–9 Mar. 1984, L. Masner M.T. (CNCI); 1 ♀, Mt Glorious, 10 Sep.–19 Nov. 1981, A. Hiller (QMBA); 1 ♀, Mt Tamborine, no date, A.P. Dodd (ANIC). **New South Wales:** 1 ♀, Ballengarra State Forest, 13 Feb. 1968, D.H. Colless (ANIC); 7 ♀, Braidwood, 28, 29 Jan. 1981, Dec. 1981, 3 Feb. 1983, R.A. Farrow (ASCU); 1 ♀, Brown Mt, Rutherford Creek, 9 Dec. 1967, Taylor, Brooks (ANIC); 1 ♀, Gravesend, 24 Jan. 1928, A.P. Dodd (ANIC); 1 ♀, Gundagai 'Orman Park', 5 May 1992 (QDPC); 1 ♀, Narrabri, 27 Jan. 1960, M. Nitkin

(ASCU); 1 ♀, Pitt Water, 28 Oct. 1932, A.P. Dodd (ANIC). **Australian Capital Territory:** 1 ♀, Canberra, Black Mountain, 7–12 Mar. 1980, A. Newton, M. Thayer (CNCI). **Victoria:** 1 ♀, Belgrave, 26 Dec. 1926, A.P. Dodd (ANIC).

Female

Length

3.7–4.05 mm (mean 3.8 mm).

Colour

Dark brown except mandibles and coxae light brown, remainder of legs yellow.

Head

Width between eyes $0.5\text{--}0.55 \times$ width of head in dorsal view; OOL 0.04–0.05 mm; LOL 0.19–0.21 mm; POL 0.33–0.48 mm; ocellar diameter 0.06–0.08 mm, $0.12\text{--}0.15 \times$ width between eyes; head with fine moderately long translucent pilosity; occiput rugulose-reticulate; posterior vertex rugose-reticulate; medial vertex punctate; dorsal frons punctate; ventral frons punctate-reticulate; malar region with radiating striae, continuing dorsally above level of interantennal process; malar space $0.37\text{--}0.5 \times$ as long as eye height; interantennal process broad and short, with lateral carinae continuing around antennal sockets, not onto frons; clypeus moderately produced and convex between lateral points; anteclypeus defined by narrow raised smooth marginal area; mandibles smooth, lower tooth $0.73\text{--}0.91 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, moderately long, translucent, becoming coarser on lateral pronotum; dorsal pronotum rugulose anteriorly, punctate posteriorly; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum punctate-reticulate; pronotal shoulders prominent, defined by transverse carina; scutum punctate-reticulate; notauli defined by deeper larger punctation; scutellum punctate-reticulate, no lateral spines defined; dorsellum only very slightly prominent, not emarginate; mesopleuron punctate-reticulate; mesosternum with moderately dense punctation; propodeum $0.47\text{--}0.56 \times$ as long as wide, punctate-reticulate laterally about medial longitudinal furrow present, with sparse long fine pilosity laterally, postero-lateral area square; indentation about nucha present.

Wings

Lightly infusate, with light-coloured fine short setae; buff-coloured stigmal spot defined, without stigmal vein.

Metasoma

$2.18\text{--}2.41 \times$ as long as wide, with fine sparse translucent pilosity; T1 $0.69\text{--}0.82 \times$ as long as upper anterior width, $0.66\text{--}0.82 \times$ as long as lower anterior width, longitudinally strigose; T2–T5 longitudinally strigose, T4–T5 with narrow medial smooth patch; T6 rugose-reticulate; S1–S5 strigose laterally, smooth medially, with scattered punctation; S2 with basal transverse ridge; S2–S3 with raised smooth felt nodes defined.

Male

Unknown.

Distribution

Scelio striatifacies is found in eastern Australia from the Townsville region to southern Victoria (Fig. 8.218).

Host

Unknown.

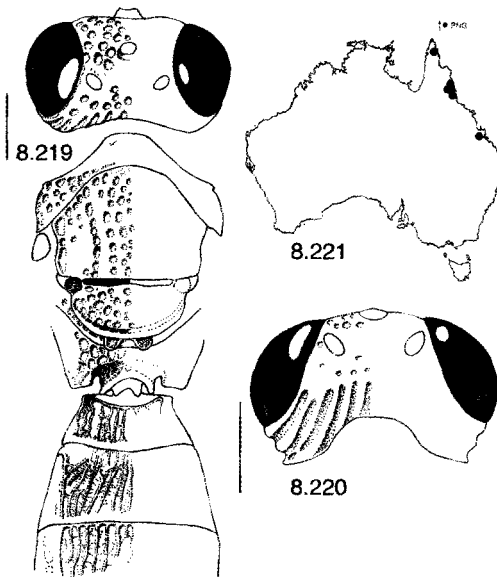
Comments

This species is not readily identified as it has no obvious characteristics, and its relationships are not clear (see comments under *S. orientalis*). Other than the characters given in the key, *S. striatifacies* belongs to a group of species that have an almost convex dorsellum, the notauli clearly defined and the body variously sculptured. *Scelio nigricoxa* Dodd, known only from two male specimens, may be the male of this species or *S. punctaticeps* (see discussion under *S. nigricoxa*). Males for this species are inferred from the phylogenetic analysis as having antennal tyloids present, similar to *S. nigricoxa*.

SCELIO SULCATICEPS DODD

(Figs 8.219–8.221)

Scelio sulcaticeps Dodd, 1927: 137.- Galloway, 1976: 107; Galloway & Austin, 1984: 11; Johnson, 1992: 489.



Figs 8.219–8.221. *Scelio sulcaticeps* Dodd: 8.219. ♀ Holotype, dorsal head to anterior T3. 8.220. ♀ Holotype, postero-dorsal head. 8.221. Distribution map. Scale lines: 0.25 mm.

Material examined*Holotype*

♀, Queensland, 'Kuranda, Q. A.P. Dodd April, 1920' (SAMA).

Other material examined

Queensland: 1 ♀, Blackdown Tablelands via Dingo, 1–6 Feb. 1981, G.B. Monteith (QMBA); 1 ♀, 2 ♂, Davis Creek N.P., 10 km E Mareeba, 17–24 Feb. 1984, L. Masner, M.T. (CNCI); 5 ♀, 12 km SSE Heathlands, 11.51S, 142.38E, 22 Mar.–25 Apr. 1992, T. McLeod, M.T., 26

Jan.–1 Mar. 1992, 1–21 Mar. 1992, P. Feeney (ANIC); 2 ♀, Hugh Nelson Ra, 21 km S Atherton, 13 Mar.–1 May 1984, Storey, Brown (ASCU, WINC); 1 ♀, Iron Range, Cape York Peninsula, 1–9 Jun. 1971, S.R. Monteith (ANIC); 1 ♂, 6 km SW Kuranda, 10 Dec. 1984–15 Jan. 1985, Storey, Halfpapp (ASCU); 1 ♀, 22 km WSW Mareeba, 7 Jan.–12 Feb. 1985, Storey, Halfpapp, M.T. (ASCU); 1 ♀, Mt Edith Forest Road, 1 m off Danbulla Road, 6 May 1967, D.H. Colless (ANIC); 1 ♀, Wongabel S.F., 6 km S Atherton, 9 Jan.–10 Feb. 1984, Storey, Brown, M.T. (WINC). **Papua New Guinea:** 1 ♀, Baiyer R., Cattle R., 9 Jul. 1974, H. Howden (CNCI); 1 ♀, Morobe Province, Wau Ecol. Inst. Aug. 1983, S. and P. Miller, P.T. (CNCI).

Female

Length

4.0–4.6 mm (mean 4.35 mm).

Colour

Dark brown except legs, basal antennae and sometimes mandibles yellow, metasoma medium brown.

Head

Width between eyes $0.4\text{--}0.45 \times$ width of head in dorsal view; OOL $0.03\text{--}0.04$ mm; LOL $0.13\text{--}0.18$ mm; POL $0.23\text{--}0.30$ mm; ocellar diameter $0.09\text{--}0.13$ mm, $0.18\text{--}0.30 \times$ width between eyes; head with fine moderately long pilosity; occiput with coarse longitudinal striations; posterior vertex and frons with moderately large punctation; medial vertex smoother with scattered punctation; malar region with coarse radiating striae, extending well onto ventral frons; malar space $0.37\text{--}0.47 \times$ as long as eye height; interantennal process narrowed ventrally, with lateral carinae continuing around antennal sockets, not onto frons; clypeus moderately well produced and convex between lateral points; anteclypeus defined by raised smooth marginal area; mandibles smooth, lower tooth $0.5\text{--}0.67 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, moderately long, translucent; dorsal pronotum smooth with fine punctation from associated pilosity; latero-dorsal pronotum rugose-reticulate with foveolae; latero-ventral pronotum punctate-reticulate to rugose-reticulate; pronotal shoulders poorly defined by raised rugosity; scutum with moderately coarse non-confluent punctation; notauli defined by a row of confluent punctures; scutellum with coarse punctation, no lateral spines defined; dorsellum prominent, emarginate, producing rounded postero-lateral points; mesopleuron punctate; mesosternum with moderately coarse confluent punctation; propodeum short, $0.30\text{--}0.39 \times$ as long as wide, rugose-reticulate, excavate dorsal of nucha, medial longitudinal furrow poorly defined, with fine pilosity laterally, postero-lateral area square; indentation about nucha deep.

Wings

Lightly infusate, with fine short golden setae; stigmal spot defined and infusate, with long stigmal vein.

Metasoma

$2.38\text{--}2.7 \times$ as long as wide; T1 $0.59\text{--}0.69 \times$ as long as upper anterior width, $0.47\text{--}0.53 \times$ as long as lower anterior width, longitudinally striate to strigose, with background reticulation; T2–T5 longitudinally to obliquely striate to strigose, with background reticulation; T6 rugose; S1–S5 coarsely strigose, S3–S5 smooth medially, S2 with basal transverse furrow and ridge; S2–S3 with finely punctate felt fields defined.

Male

As for female except antennal segment 5 similar in size and shape to 4 and 6 without tyloid, claval segments with basiconic peg sensilla; mesopleuron finely punctate, with medial smooth patch; S3 with raised smooth transverse band basally.

Distribution

Scelio sulcaticeps is known from east coastal Queensland and Papua New Guinea (Fig. 8.221).

Host

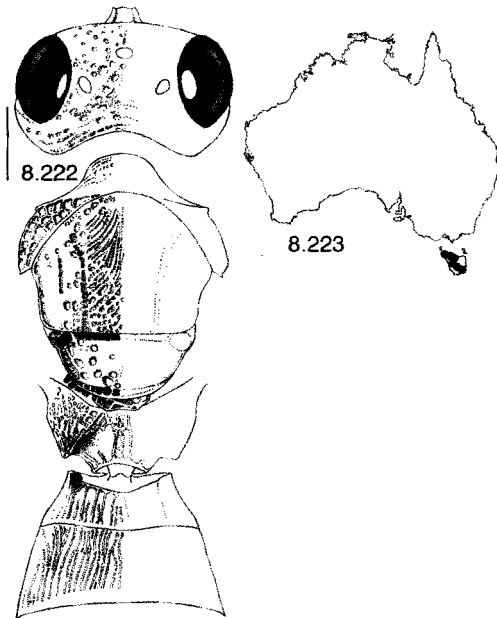
Unknown.

Comments

Scelio sulcaticeps is the sister species of *S. naumanni* (see comments under *S. naumanni*). This is a distinct and easily recognised species based on the coarse longitudinal striae on the posterior vertex.

SCELIO TASMANIENSIS DANGERFIELD & AUSTIN SP. NOV.

(Figs 8.222, 8.223)



Figs 8.222, 8.223. *Scelio tasmaniensis* sp. nov.: 8.222. ♀ Holotype, dorsal head to T2. 8.223. Distribution map. Scale line: 0.25 mm.

Material examined

Holotype

♀, Tasmania, '41.47S 145.53E 4 km E Rosebery TAS 16 Jan–1 Feb 1983 I.D. Naumann & J.C. Cardale ex pantrap' (ANIC).

Paratypes

Tasmania: 3 ♀, same data as holotype; 5 ♀, 1 ♂, 14 km S Bronte Park, 42.15S, 146.29E, 15 Jan.–3 Feb. 1983, I.D. Naumann, J.C. Cardale, M.T. (ANIC); 1 ♀, 9 km S Bronte Park,

42.12S, 146.30E, 15 Jan.–3 Feb. 1983, I.D. Naumann, J.C. Cardale, P.T. (ANIC); 1 ♀, 2 km NW Derwent Bridge, 24–28 Jan. 1980, A. Newton, M. Thayer (WINC); 5 ♀, Ewart Creek, 41.58S, 145.28E, 16 Jan.–2 Feb. 1983, I.D. Naumann, J.C. Cardale, P.T. (ANIC); 1 ♂, 12 km WbyS Frodshams Pass, 24 Jan. 1983, I.D. Naumann, J.C. Cardale, P.T. (ANIC); 2 ♀, Mt Field NP, Wombat Moor, 30 Jan.–5 Feb. 1980, A. Newton, M. Thayer, P.T. (WINC); 2 ♀, 9 km WbyS Poatina, 41.48S, 146.52E, 20 Jan. 1983, I.D. Naumann, J.C. Cardale (ANIC).

Female

Length

4.4–4.9 mm (mean 4.8 mm).

Colour

Dark brown except antennal toruli and pedicel, apical mandibles, trochanter, tibia and tarsi dark yellow to light brown.

Head

Width between eyes $0.49\text{--}0.52 \times$ width of head in dorsal view; OOL 0.06–0.08 mm; LOL 0.21 mm; POL 0.33 mm; ocellar diameter 0.08–0.09 mm, $0.15 \times$ width between eyes; head with fine short translucent pilosity; occiput rugulose-reticulate; posterior vertex rugose-reticulate, with transverse trend and scattered punctures; medial vertex with shallow punctation and irregular striae; frons punctate-reticulate to punctate; malar region with short radiating striae, becoming punctate immediately dorsal of interantennal process; malar space $0.5\text{--}0.61 \times$ as long as eye height; interantennal process short, broad, with lateral carinae continuing around antennal sockets; clypeus moderately produced and convex between lateral points; anteclypeus defined by broad smooth area; mandibles smooth, lower tooth $0.8\text{--}0.85 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, long, translucent; dorsal pronotum rugulose with scattered punctation; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum smooth anteriorly, becoming rugulose-reticulate posteriorly; pronotal shoulders prominent, defined by transverse carina; anterior scutum smooth or with faint radiating striations, posterior scutum strigose to punctate-reticulate, lateral scutum smooth, with sparse large punctures and parapsidal groove medially; notauli well defined, crenulate; scutellum smooth, with scattered punctures, sometimes with radiating striations, no lateral spines defined; dorsellum prominent and rugose, sometimes slightly emarginate; mesopleuron striate; mesosternum virtually smooth, sometimes with sparse large punctures; propodeum $0.45 \times$ as long as wide, punctate-reticulate laterally, becoming strigose-punctate medially about irregular longitudinal carinae, defining shallow to moderately deep medial longitudinal furrow, with fine long translucent pilosity laterally, postero-lateral area forming a point; indentation about nucha broad.

Wings

Moderately infusate, with dark moderately long fine setae; dark stigmal spot defined, with short stigmal vein.

Metasoma

$2.05\text{--}2.27 \times$ as long as wide, with sparse translucent pilosity; T1 $0.5\text{--}0.56 \times$ as long as upper anterior width, $0.39\text{--}0.42 \times$ as long as lower anterior width, longitudinally strigose; T2 longitudinally strigose to striate; T3 rugulose-reticulate medially, becoming strigose laterally; T4–T5 longitudinally strigose in anterior half, becoming smooth posteriorly; T6 sparsely foveolate; S1 longitudinally strigose; S2–S5 smooth with scattered fine punctation; S2 without basal transverse ridge and with poorly defined felt nodes.

Male

As for female except sculpturing generally heavier; antennal tyloids not clearly defined; femora swollen in basal half.

Distribution

This species is known only from Tasmania (Fig. 8.223).

Host

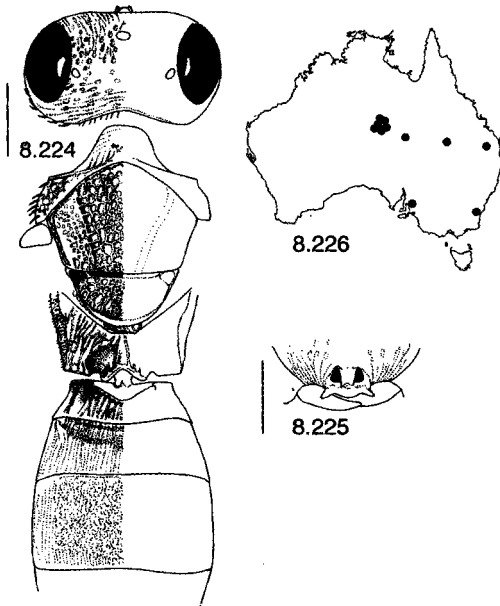
Unknown.

Comments

Scelio tasmaniensis is readily identified based on its large size, robust body, scutum with extensive smooth areas and medial striae, and punctate malar region. It is named after the island where it has been collected and, along with *S. pigotti* sp. nov., is one of only two species of *Scelio* thought to be endemic to Tasmania. *Scelio tasmaniensis* is basal within the clade defined by 10 segmented antennae in males (Fig. 6.2, node 1).

SCELIO UNIDENTIS DANGERFIELD & AUSTIN SP. NOV.

(Figs 8.224–8.226)



Figs 8.224–8.226. *Scelio unidentis* sp. nov.: 8.224. ♀ Holotype, dorsal head to T3. 8.225. ♀, lower anterior head, showing unidentate mandible and reduced clypeus. 8.226. Distribution map. Scale lines: 0.25 mm.

Material examined*Holotype*

♀, Australian Capital Territory, 'Black Mtn. A.C.T. Jan. 1988 D.H. Colless Malaise trap/ethanol' (ANIC).

Paratypes

Queensland: 1 ♀, Charleville, 4.3 km on rd to Adavale, 1 Mar. 1989, E. Dahms, G. Sarnes, sweeping on *Themeda & Aristida* (QMBA); 6 ♀, Chinchilla, 16 Mar. 1927, A.P. Dodd (ANIC); 1 ♀, Chinchilla, Mar. 1927, B.A. Smith (ANIC). **Australian Capital Territory:** 5 ♀, Black Mountain, 35.16S, 149.06E, Jan. 1981, Jan. 1982, Feb. 1982, I.D. Naumann, J.C. Cardale, M.E. Matthews (ANIC). **South Australia:** 1 ♀, Brookfield Cons. Pk, 34.19S, 139.30E, 24 & 26 Nov. 1992, I. Naumann, J. Cardale (ANIC). **Northern Territory:** 4 ♀, 35 km NbyW Alice Springs, 23.22S, 133.48E, 6–27 May 1978, J.C. Cardale (ANIC); 1 ♀, 32 km WNW Alice Springs, 23.36S, 133.35E, 8 Oct. 1978, J.C. Cardale (ANIC); 1 ♀, Todd River, 9 km NbyE Alice Springs, 23.38S, 133.53E, 10 Oct. 1978, J.C. Cardale (ANIC); 1 ♀, 1 km E Corroboree Rock, 23.38S, 134.16E, 28 May 1978, J.C. Cardale (ANIC); 1 ♀, 5 km SW Corroboree Rock, 23.04S, 134.13E, 25 May 1978, J.C. Cardale (ANIC); 1 ♀, 56 km SbyE Alice Springs, 24.11S, 134.01E, 3 Oct. 1978, J.C. Cardale (ANIC); 5 ♀, 42 km SWbyS Alice Springs, 24.03S, 133.37E, 6 May 1978, J.C. Cardale (ANIC); 1 ♀, 80 km SWbyS Alice Springs, 24.16S, 133.25E, 16 May 1978, J.C. Cardale (ANIC); 10 ♀, NW Birdsville, near Lake Munoonie, 12–16 Nov. 1976, R. Raven, P.T. desert area (ASCU).

Female

Length

3.65–3.95 mm (mean 3.8 mm).

Colour

Orange except head, apical antennae T5 and T6 black, apical T2–T4 brown. The scutum and metanotum vary and may be black, brown or orange.

Head

Width between eyes 0.48–0.55 × width of head in dorsal view; OOL 0.01–0.03 mm; LOL 0.3 mm; POL 0.46 mm; ocellar diameter 0.06–0.08 mm, 0.1–0.14 × width between eyes; vertex with fine short sparse pilosity, coarse translucent on frons and temples; occiput strigose; posterior vertex transversely strigose; medial vertex with sparse moderately fine punctation; dorsal frons punctate-reticulate with longitudinal trend; malar region with radiating striae and associated coarse punctation reaching halfway up frons; malar space 0.5–0.8 × as long as eye height; interantennal process very short, broad, pronounced, with lateral carinae continuing around antennal sockets; clypeus slightly produced and convex between long lateral points; anteclypeus defined by smooth marginal area; mandibles smooth, only just meeting medially, tapering to apical point, dorsal tooth absent.

Mesosoma

Pilosity coarse, stout, translucent, particularly on lateral pronotum; dorsal pronotum with fine transverse striation; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum rugose-reticulate anteriorly, becoming transversely strigose posteriorly; pronotal shoulders prominent, defined by transverse carina; scutum irregularly punctate-reticulate; notauli well defined, crenulate; scutellum punctate-reticulate, no lateral spines defined; dorsellum prominent, emarginate, sometimes forming latero-posterior points; mesopleuron transversely striate; mesosternum mostly smooth, with fine lateral punctation; propodeum 0.32–0.42 × as long as wide, with longitudinal to oblique rugose-reticulation, medial longitudinal furrow present, defined by longitudinal carinae, with fine white moderately dense pilosity laterally, postero-lateral area square; indentation about nucha present.

Wings

Moderately lightly infusate, with short fine setae; dark stigmal spot well defined, with long stigmal vein.

Metasoma

1.8–2.0 × as long as wide, with fine pilosity laterally; T1 0.3–0.48 × as long as upper anterior width, 0.2–0.3 × as long as lower anterior width, longitudinally rugose-reticulate; T2 longitudinally striate, becoming smoother medially; T3 with fine rugulose-reticulation; T4 finely rugose-reticulate in anterior half, becoming longitudinally strigose posteriorly; T5 longitudinally strigose; T6 rugose-reticulate; S1 rugose-reticulate; S2–S5 rugulose-reticulate laterally, becoming smoother medially; S2 with basal transverse carinae, not forming a ridge; S2–S3 without felt lines or nodes defined.

Male

Unknown.

Distribution

Scelio unidentis is known from central, eastern and south-eastern Australia (Fig. 8.226).

Host

Unknown.

Comments

Phylogenetic relationships are discussed under *S. chortoicetes* and *S. pilosifrons*. *Scelio unidentis* and *S. chortoicetes* can be easily identified from all other Australian *Scelio* by their evenly pointed, unidentate mandibles. However, two species are quite different and can be separated on numerous characters including their colour, shape of the dorsellum, and general body sculpturing. Males of this species are inferred from the phylogenetic analysis as lacking antennal tyloids. This species is named from the Latin ‘uni’ meaning ‘one’ and ‘dentis’ meaning ‘tooth’ because of the single-toothed mandibles.

SCELIO VARIPUNCTATUS DODD

(Figs 8.227, 8.228)

Scelio varipunctatus Dodd, 1914c: 29.- Dodd, 1914b: 111 (see *Comments* below); Kieffer, 1926: 338; Dodd, 1927: 139; Galloway, 1976: 107; Galloway & Austin, 1984: 11; Johnson, 1992: 486.

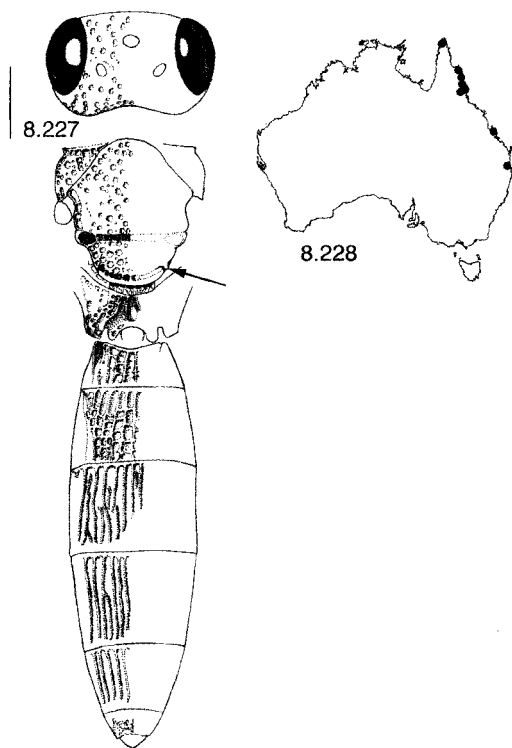
Scelio varipunctatus claripes Dodd, 1927: 140; Galloway, 1976: 107; Galloway & Austin, 1984: 11. *Syn. nov.*

Material examined*Holotype*

♀ (*S. varipunctatus*), Queensland, ‘Cairns’ (SAMA); ♀ (*S. v. claripes*), ‘Mossman, N.Q., April 1920’ (SAMA).

Other material examined

Queensland: 1 ♀, Black Mountain via Kuranda, 16.49S, 145.38E, 14 Sep.–12 Oct. 1982, G. Simpson (ANIC); 11 ♀, 1 ♂, Brisbane, Indooroopilly, 8 Feb. 1977, Feb. 1978, 8–21 Mar. 1983, I.D. Galloway, Z. Boucek (10, ANIC; 1, WINC); 1 ♀, Gordonvale, May 1921, A.P. Dodd (ANIC); 1 ♀, Cooper Crk Beach, 13 km N Daintree River, 25 Mar. 1976, I.D. Galloway (ANIC); 1 ♀, Heathlands, 11.45S, 142.35E, 1–21 Mar. 1992, P. Feehney (ANIC); 1 ♀, 14 km WbyN Hope Vale Mission, 8–10 Oct. 1980, J.C. Cardale (ANIC); 1 ♀, Innisfail, Nov. 1919, no collector (ANIC); 1 ♂, Mareeba, 31 Jul.–7 Aug. 1992, D.H. Habeck



Figs 8.227, 8.228. *Scelio varipunctatus*
Dodd: 8.227. ♀ Holotype, dorsal habitus,
lateral node on scutellum arrowed.
8.228. Distribution map. Scale line:
0.25 mm.

(ANIC); 1 ♀, Rex Range Lookout via Julatten, 9 Nov.–2 Dec. 1981, no collector (ANIC); 1 ♂, 23 km N Yeppoon, 31 Oct. 1975, I.D. Galloway (CNCI).

Female

Length

3.8–4.7 mm (mean 4.15 mm).

Colour

Dark brown except legs medium brown.

Head

Width between eyes $0.47\text{--}0.52 \times$ width of head in dorsal view; OOL $0.05\text{--}0.06$ mm; LOL $0.15\text{--}0.18$ mm; POL $0.23\text{--}0.29$ mm; ocellar diameter $0.08\text{--}0.1$ mm, $0.16\text{--}0.18 \times$ width between eyes; head with fine short translucent pilosity, with orange tinge on vertex; occiput rugulose; posterior vertex moderately punctate; medial vertex sparsely punctate; frons moderately punctate; malar region with short radiating striae, becoming punctate immediately dorsal to level of interantennal process; malar space $0.4\text{--}0.53 \times$ as long as eye height; interantennal process narrowing ventrally, with lateral carinae continuing around antennal sockets; clypeus well produced between lateral points, with medial margin straight to slightly concave; anteclypeus defined by raised smooth marginal area; mandibles smooth, lower tooth $0.7\text{--}0.83 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity moderately long, sparse, fine, with orange tinge; dorsal pronotum virtually smooth, with fine sparse punctation; latero-dorsal pronotum punctate, becoming reticulate anteriorly; latero-ventral pronotum smooth anteriorly, becoming punctate posteriorly; pronotal

shoulders prominent, defined by transverse carina; scutum with moderately sparse coarse punctation; notauli not defined; scutellum coarsely punctate, with lateral posteriorly directed spines defined; dorsellum moderately prominent, not emarginate; mesopleuron punctate to punctate-reticulate; mesosternum punctate; propodeum $0.49\text{--}0.53 \times$ as long as wide, punctate to punctate-reticulate laterally about short broad medial longitudinal furrow, covered with fine moderately sparse pilosity, postero-lateral area obliquely truncate; indentation about nucha present.

Wings

Moderately infusate, with short fine dense setae; stigmal spot large, globular, infusate, with well-defined tubular infusate apical vein ending in small rounded swelling.

Metasoma

$2.8\text{--}3.21 \times$ as long as wide, with fine sparse pilosity, varying from short and translucent anteriorly, becoming slightly coarser with orange tinge posteriorly; T1 $0.63\text{--}0.72 \times$ as long as upper anterior width, $0.47\text{--}0.6 \times$ as long as lower anterior width, rugose-reticulate with longitudinal trend; T2 rugose-reticulate; T3–T5 longitudinally strigose; T6 rugose; S1–S5 longitudinally striate to strigose, with narrow smooth medial patch, S2 with low transverse basal ridge; S2–S3 with raised finely punctate felt nodes defined.

Male

As for female except vertex inside ocelli slightly raised; antennal segment 5 with elongate tyloid present on dorsal surface.

Distribution

This species is known from coastal regions of Queensland (Fig. 8.228).

Host

Unknown.

Comments

Dodd (1927) described *claripes* as a variety of the nominal species *S. varipunctatus*, and Galloway (1976) later gave it subspecies status. However, there is no justification for recognising this subspecies as it is easily accommodated within the normal range of variation, and has been synonymised here. It is the sister species of *S. pambertoni* from New Guinea, and together are defined by having lateral scutellar spines. These species along with *S. setiger* from the Solomon Islands are defined by the dark infuscation of Rs in the fore wing (Fig. 6.2, node 12), a character shared with the distant outgroup *Archaeoteleia mellea*. Further relationships of this species are discussed under *S. gobar*. There is some confusion in the literature regarding the first reference to *S. varipunctatus*. The original description (here quoted as Dodd 1914c) is previously given as 1914 (e.g. Johnson 1992) or 1915 (e.g. Dodd 1927; Galloway 1976; Galloway & Austin 1984). It appears as though volume 40 (1914) of *Archive Naturgeschichte* was not available until early 1915, however Dodd (1914b) referred to *S. varipunctatus* in a key to *Scelio* species that came out in December 1914.

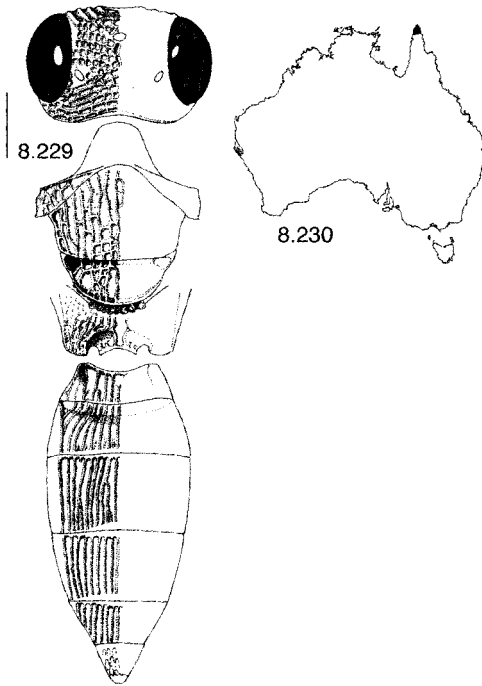
SCELIO ZBOROWSKII DANGERFIELD & AUSTIN SP. NOV.

(Figs 8.229, 8.230)

Material examined

Holotype

♀, Queensland, '11.45S 142.35E Heathlands QLD 5 Apr.–13 May 1993 P. Zborowski, A. Roach Flight intercept trap' (ANIC).



Figs 8.229, 8.230. *Scelio zborowskii* sp. nov.: 8.229. ♀ Holotype, dorsal habitus. 8.230. Distribution map. Scale line: 0.25 mm.

Female

Length

4.0 mm.

Colour

Orange except head, funicle, scutellum, metanotum and metasoma dark brown.

Head

Width between eyes $0.48 \times$ width of head in dorsal view; OOL 0.03 mm; LOL 0.3 mm; POL 0.43 mm; ocellar diameter 0.08 mm, $0.14 \times$ width between eyes; head with short fine pilosity; occiput virtually smooth, with scattered fine punctation; vertex and dorsal frons punctate-reticulate; malar region with well-defined radiating striae which arch over, becoming reticulate and meeting above speculum; malar space $0.4 \times$ as long as eye height; interantennal process short, broad, with lateral carinae continuing around antennal sockets; clypeus produced and convex between lateral points; anteclypeus defined by narrow raised smooth area; mandibles smooth, lower tooth $0.43 \times$ upper tooth, dorsal tooth absent.

Mesosoma

Pilosity fine, short, sparse; dorsal pronotum with faint transverse rugulosity; latero-dorsal pronotum rugose-reticulate; latero-ventral pronotum smooth anteriorly, becoming rugose-reticulate posteriorly; pronotal shoulders prominent, defined by transverse carina; scutum rugulose-reticulate, with distinct longitudinal trend; notauli not defined amongst sculpturing; scutellum rugose-reticulate, no lateral spines defined; dorsellum prominent, fan-like, very slightly emarginate; mesopleuron rugose-reticulate; mesosternum punctate-reticulate; propodeum $0.36 \times$ as long as wide, rugose reticulate, medial longitudinal furrow present, with fine short pilosity laterally, postero-lateral area square; indentation about nucha present.

Wings

Lightly infuscate in basal third, darker in apical two-thirds, with short fine dark setae; stigmal spot defined, without apical vein.

Metasoma

2.4 × as long as wide, with fine pilosity laterally; T1 0.6 × as long as upper anterior width, 0.5 × as long as lower anterior width, longitudinally strigose; T2–T5 longitudinally striate, T3 slightly smoother and reticulate medially; T6 punctate-reticulate; S1–S5 longitudinally strigose; S2 with shallow basal transverse ridge; S2–S3 with felt nodes defined.

Male

Unknown.

Distribution

Scelio zborowskii is only known from the type specimen collected at Heathlands, northern Cape York (Fig. 8.230).

Host

Unknown.

Comments

The relationships of this species are discussed under *S. mareebaensis* and *S. notabilis*. It is named after Paul Zborowski in honour of the many specimens of *Scelio* collected by him.

TREATMENT OF UNASSIGNED MALES

A large number of male specimens could not be associated with females of the species described above. Rather than describe these males as separate species, knowing that many of them would be synonymised in the future when they can be associated with females, we have treated them as species or species groups A to Z. In most cases these represent distinct species, but in several instances (e.g. groups I–L) they correspond to species groups. The latter groups show a level of morphological variability that indicates more than one species is present, but it has not been possible to separate them with confidence. Species/groups A–Z are included in the key to males (Chapter 7) and are diagnosed below to facilitate their recognition. Information is also presented on their general distribution, potential relationships, and material examined.

Scelio* sp. ADiagnosis*

Tyloids absent on antennal segment 5; ocellar diameter large; scutum smooth with scattered deep punctation; propodeum indented about nucha; venation of fore wing darkly infusate; medial mesopleuron finely punctate; T1 long; S3 sculptured at base without raised smooth transverse band.

Distribution

Known from Papua New Guinea (1♂, CNCI).

Comments

This male is very similar to *S. sulcaticeps* Dodd but can be distinguished by the sculpturing on the medial mesopleuron, the lack of a raised transverse smooth band at the base of S3 and the more darkly infusate stigmal spot and apical vein.

Scelio* sp. BDiagnosis*

Tyloids absent on antennal segment 5; malar region with weak short radiating striae changing to scattered punctation about speculum; scutum with coarse punctation; propodeum with indentation about nucha; T1 long, 0.57–0.60 × as long as upper anterior width.

Distribution

Known from Queensland, South Australia, New South Wales and the Australian Capital Territory (4♂, WINC; 3♂, ANIC; 1♂, QMBA).

Comments

Three South Australian specimens have the same collection data as females of *S. improcerus* Dodd.

***Scelio* sp. C**

Diagnosis

Tyloids absent on antennal segment 5; malar region with weak short radiating striae changing to scattered punctation about speculum; propodeum with indentation about nucha; T1 long, $>0.75 \times$ as long as upper anterior width, scutum with coarse punctation.

Distribution

Known from New South Wales and south-east Queensland (2♂, ANIC).

***Scelio* sp. D**

Diagnosis

Tyloids absent on antennal segment 5; scutum with coarse punctation, malar region with long radiating striae about speculum; propodeum with indentation about nucha; T1 long, $0.85 \times$ as long as upper anterior width.

Distribution

Known from south-east Queensland (1♂, ANIC; 1♂, UQIC).

***Scelio* sp. E**

Diagnosis

Tyloids absent on antennal segment 5; malar region with long radiating striae about speculum; scutum with coarse punctation; propodeum with indentation about nucha, postero-lateral corners rounded to obliquely truncate; legs brown with yellow joints; T1 long, $0.63\text{--}0.75 \times$ as long as upper anterior width.

Distribution

Known from Tasmania (4♂, ANIC).

***Scelio* sp. F**

Diagnosis

As for species E but with postero-lateral corners of propodeum broad and square; legs yellow apart from brown coxae.

Distribution

Known from Tasmania (2♂, ANIC).

***Scelio* sp. G**

Diagnosis

Tyloids absent on antennal segment 5; anterior head sharply prominent between eyes, forming broad ridges about eye margins; propodeum with indentation about nucha; T1 broad, $<0.5 \times$ as long as lower anterior width.

Distribution

Known from northern Queensland (25♂, ANIC; 2♂, UQIC).

Comments

The prominence on the anterior head of this species is unusual, but is also found in species Q, the latter differing in having antennal tyloids present.

Scelio species-group H*Diagnosis*

Tyloids absent on antennal segment 5; anterior head becoming gradually prominent between eyes; propodeum with narrow deep indentations about the nucha; T1 broad $<0.5 \times$ as long as lower anterior width; lateral felt fields on S2 elongate, slightly raised.

Distribution

Known from south-eastern Queensland, New South Wales, Australian Capital Territory, Victoria and Tasmania (13♂, ANIC; 1♂, ASCU).

Host

There are possibly two or more species in this group, indicated by variation in the dorsellum. Two specimens were collected from a field cage with *Phaulacridium vittatum*.

Scelio species-group I*Diagnosis*

Tyloids absent on antennal segment 5; anterior head becoming gradually prominent between eyes; propodeum with narrow deep indentations about nucha; mesosternum smooth and shiny medially; T1 broad $<0.5 \times$ as long as lower anterior width.

Distribution

Known from Alice Springs, Northern Territory, north coastal and south-eastern Queensland, Australian Capital Territory, Victoria, Tasmania and South Australia (23♂, ANIC; 13♂, ASCU; 6♂, QMBA; 14♂, WINC; 1♂, QMBA).

Comments

The male paratype of *S. improcerus* Dodd is part of this group (see also comments under *S. improcerus*).

Scelio species-group J*Diagnosis*

Tyloids absent on antennal segment 5; anterior head becoming gradually prominent between eyes; notauli clearly defined among punctate sculpturing; propodeum with narrow deep indentations about nucha; mesosternum sculptured medially; fore wing hyaline; T1 broad, $<0.5 \times$ as long as lower anterior width; S2 and S3 with felt fields absent.

Distribution

Known from Alice Springs, New South Wales and South Australia (13♂, ANIC).

Scelio species-group K*Diagnosis*

Tyloids absent on antennal segment 5; anterior head becoming gradually prominent between eyes; propodeum with narrow deep indentations about nucha; mesosternum smooth and shiny medially, sometimes with a few scattered punctures; T1 broad, $<0.5 \times$ as long as lower anterior width; S2 and S3 with felt fields absent.

Distribution

Known from northern Australia Queensland, Northern Territory and Western Australia (1 ♂, ANIC; 2 ♂, CNCI).

***Scelio* species-group L**

Diagnosis

Tyloids absent on antennal segment 5; anterior head becoming gradually prominent between eyes; propodeum with narrow deep indentations about nucha; fore wing infusate in dorso-apical half; T1 broad, $<0.5 \times$ as long as lower anterior width; S2 with felt fields present.

Distribution

Known from Mt Tamborine, south-eastern Queensland and Adelaide, South Australia (1 ♂, ANIC; 3 ♂, WINC).

Comments

The three specimens from Adelaide were collected by Malaise trap at the same time and locality as a female of *S. grbini* sp. nov. was taken in a nearby yellow pan trap. No other *Scelio* were collected in the area, which may indicate that these are the males of *S. grbini*. However, these males are morphologically quite distinct from the females of *S. grbini*.

***Scelio* sp. M**

Diagnosis

Tyloids absent on antennal segment 5; anterior head becoming gradually prominent between eyes; propodeum with narrow deep indentations about nucha; mesosternum distinctly sculptured medially; wings hyaline; T1 broad, $<0.5 \times$ as long as lower anterior width; S2 and S3 with felt fields absent.

Distribution

Known from north-eastern Queensland (7 ♂, ANIC; 2 ♂, QMBA).

***Scelio* sp. N**

Diagnosis

Tyloid present in apical half of antennal segment 5, elongate; mandible with basal reticulate sculpturing, dorsal mandibular tooth absent; interantennal process with lateral carina continuing onto speculum; propodeum with moderately deep indentation about nucha, postero-lateral corners of propodeum square; felt fields absent; pilosity on body fine.

Distribution

Known from north-eastern Queensland (1 ♂, QMBA).

***Scelio* species-group O**

Diagnosis

Vertex with pustulate sculpturing; tyloids present; basal mandible smooth; propodeum with indentation about nucha.

Distribution

Known from numerous localities throughout north-eastern Queensland (20 ♂, ANIC; 16 ♂, QMBA; 4 ♂, UQIC).

Comments

This group is easily recognised by the pustulate sculpturing on the vertex, which is otherwise only known for females of *S. mareebaensis* sp. nov. A paratype male of *S. perspicuus* Dodd along with a series of males with the same collection data belong to this group. The level of morphological variation within this group indicates that a complex of species is present. However, the variation is not distinct enough to separate the group further.

Scelio* sp. PDiagnosis*

Antennal segments 6–10 small, similar in length to segments 3–5 combined; eyes small; medial vertex with striations; mesosoma broad and stout; metasoma broadly lens-shaped.

Distribution

Known from central coastal Queensland (2♂, UQIC).

Scelio* sp. QDiagnosis*

Anterior head with exaggerated prominence between eyes; antennal tyloids present.

Distribution

Known from Queensland and New South Wales (6♂, ANIC; 1♂, ASCU; 6♂ QMBA; 3♂, QDPC; 1♂, UQIC).

Comments

The exaggerated prominence between the eyes is not known in the females of any species. The prominence is similar to that of males of species G, but in this species it is less pronounced. Species G also lacks antennal tyloids.

Scelio* species-group RDiagnosis*

Tyloid present as a sub-apical node; antennal segments 6–10 not reduced; dorsal frons not projecting anteriorly; basal mandible smooth; vertex with coarse punctation; lateral nodes of scutellum not enlarged; dorsellum only slightly raised above level of metanotum; propodeum with indentation about nucha deep; pilosity on body fine.

Distribution

Known from several localities throughout coastal Queensland (13♂, ANIC; 1♂, QDPC; 1♂, QMBA; 3♂, UQIC).

Comments

Members of this group are most similar to the females of *S. amoenus* Dodd and *S. notabilis* Dodd, but differ from *S. amoenus* in having longer pilosity, the mesopleuron smooth medially, and T3 not coarsely reticulate; and *S. notabilis* in having the antennae all bright yellow, the vertex and frons punctate-reticulate without any transverse trend; the scutum punctate-reticulate without longitudinal trend, and the propodeum with the latero-anterior smooth patches less distinct.

Scelio* species-group SDiagnosis*

Tyloid present as an elongate ridge; basal mandible smooth; pilosity on temples coarse; scutum and scutellum with moderately coarse punctation, without longitudinal trend;

dorsellum moderately raised, not emarginate; mesosternum mostly smooth ventrally, with scattered moderately fine punctation laterally; propodeum with indentation about nucha deep; T1 elongate, $\leq 0.7 \times$ as long as upper anterior width; T2–T6 with longitudinal strigosity.

Distribution

Known from New South Wales, Australian Capital Territory and Tasmania (5♂, ANIC; 1♂, ASCU).

Comments

These males are most similar to the females of *S. matthewsi* sp. nov. and *S. parvicornis* Dodd.

***Scelio* sp. T**

Diagnosis

Tyloid present as an elongate ridge in apical half; basal mandible smooth; pilosity on temples coarse; scutum and scutellum with moderately coarse punctation, without longitudinal trend; dorsellum moderately raised, not emarginate; mesosternum with well-defined uniform sculpturing throughout; propodeum with indentation about nucha deep; T1 elongate, $\leq 0.7 \times$ as long as upper anterior width; T3 finely reticulate.

Distribution

Known from south-eastern Queensland and Australian Capital Territory (3♂, ANIC).

***Scelio* sp. U**

Diagnosis

Tyloid present as an elongate ridge; basal mandible smooth; pilosity on temples coarse; scutum and scutellum with moderately coarse punctation, without longitudinal trend; dorsellum moderately raised, not emarginate; mesosternum with well-defined uniform sculpturing throughout; propodeum with indentation about nucha deep; T1 elongate, $\leq 0.7 \times$ as long as upper anterior width; T3 longitudinally striate with background reticulation.

Distribution

Known from New South Wales (2♂, ANIC).

Comments

This species is similar to species T but the tyloid ridge is longer and has distinct striations on T3.

***Scelio* sp. V**

Diagnosis

Tyloid present as an elongate ridge; vertex and antero-medial scutum with distinct coarse but sparse punctures and fine background rugulosity; basal mandible smooth; pilosity on temples coarse; medial scutum and scutellum with moderately coarse punctation; lateral scutum smooth with sparse coarse punctures, without longitudinal trend; dorsellum moderately raised, not emarginate; mesosternum with well-defined uniform sculpturing throughout; propodeum with indentation about nucha deep; T1 elongate, $\leq 0.7 \times$ as long as upper anterior width.

Distribution

Known only from Braidwood, New South Wales (3♂, ASCU).

***Scelio* species-group W**

Diagnosis

Tyloid present as an elongate ridge; antennae dark brown; vertex with coarse punctation; scutum with coarse irregular punctation; mesosternum punctate; dorsellum only slightly raised above lateral metanotum, not emarginate; propodeum with indentation about nucha deep; T1 long, with upper anterior width subequal to lower anterior width; pilosity on body fine.

Distribution

Known from Queensland, New South Wales, Australian Capital Territory and Victoria (11 ♂, ANIC; 13 ♂, ASCU; 7 ♂, QDPC; 1 ♂, QMBA; 2 ♂, UQIC).

Comments

Variation in the metasomal length to width ratio indicates that more than one species is present in this group. It is most similar to the females of *S. parvicornis* and *S. striatifacies*.

***Scelio* sp. X**

Diagnosis

Body small, 3.3–3.8 mm in length; antennal segment 5 large, with tyloid on lateral edge; scutum with notauli moderately well defined; coxae with brown patches; fore femur not enlarged, T3–T4 with broad smooth medial patch; pilosity on body generally long.

Distribution

Known from several localities throughout Queensland (5 ♂, ANIC; 4 ♂, CNCI; 1 ♂, ASCU; 7 ♂, QDPC).

Comments

These males are similar to *S. gobar* but can be separated by their smaller size. They are possibly the males of *S. pseudaustralis*, but at present there is no evidence to confirm this association.

***Scelio* sp. Y**

Diagnosis

Similar to *S. gobar* except legs very dark brown; metasoma more elongate.

Distribution

Known from the Solomon Islands (1 ♂, BMNH).

***Scelio* sp. Z**

Diagnosis

Similar to *S. gobar* except legs very dark brown.

Distribution

Known from south-eastern Queensland, New South Wales and Victoria (3 ♂, ANIC; 1 ♂, CNCI; 2 ♂, QDPC; 1 ♂, UQIC).

CHAPTER 9

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INDEX TO SCELIONID GENERA AND SPECIES (*taxonomic descriptions in bold*)

- Acanthoscelio* 58, 68, 70, 72–74, 88
Ambyscelio 88
Anteromorpha 66
Archaeoscelia 68
Archaeoteleia 58–60, 68
Archaeoteleia mellea 68, 70, 73, 74
Archaeoteleia pygmaea 59
Brachyscelio 59, 60
Brachyscelio cephalotes 60
Brachyscelio dubius 60
Calliscelio 66
Ceratobaeus 64
Dicroscelio 58, 68, 70, 72–74, 88
Duta 66
Freniger 88, 89
Harringtonia 66
Heptascelio 68, 70, 72–74, 88
Lepidoscelio 18, 68, 70, 72–75, 88, 89
Macrotelia gobar 141
Neuroscelio 59, 60
Neuroscelio nervalis 60
Nixonia 88
Oreiscelio 68, 70, 72–74, 88
Pseudoheptascelio 47, 88, 89
Pseudoheptascelio cornopis 46
Psilanteris 68
Scelio 11, 12, 14–19, 21, 24–27, 29–36, 40, 41, 47, 50, 52, 54, 56–58, 61, 63, 64, 66, 68, 72, 75, 76, **88–90**
Scelio aegyptiacus 14–17, 19, 43
Scelio affinis 102
Scelio africanus 37, 43
Scelio amoenus 70, 73, 74, 81, **91–2**, 235
Scelio anmarae 70, 73, 74, 81, 90, **93–4**, 117
Scelio annae 70, 73, 74, 80, **94–6**
Scelio anyirambo 70, 73, 74, 79, 81, **96–7**
Scelio asperatus 56, 70, 73, 74, 77, 86, 96, 98–102, 104, 160, 169, 189
Scelio australiensis 102
Scelio australis 89, 104, 141, 146
Scelio bipartitus 12, 14, 15, 19, 25, 26, 33, 42, 43, 48, 49, 56, 85, 89, 102–4, 146, 173, 189
Scelio borroloolensis 70, 72–74, 78, 90, **105–6**, 163, 204
Scelio bronae 70, 73, 74, 82, **106–7**, 183
Scelio calopteni 12
Scelio cheops 43
Scelio chortoitetes 5, 14, 17, 27, 31, 33, 48, 49, 51–53, 70, 73, 74, 76, 83, 85, **108–15**, 165, 200
Scelio commixtus 44
Scelio concinnus 70, 73, 74, 80, 94, 115–7, 165
Scelio contractus 70, 73, 74, 78, 117–9, 139, 198
Scelio corion 44
Scelio cruentatus 70, 73, 74, 83, **119–21**
Scelio diemenensis 70, 73, 74, 82, **121–3**, 192
Scelio doddi 70, 73, 74, 80, **123–5**
Scelio ernstii 44
Scelio erythropus 70, 73, 74, 82, 90, **125–7**, 135, 210
Scelio facialis 37, 44
Scelio flavicornis 30, 33, 48–50, 83, 127–9, 163, 201, 204, 218
Scelio nr. flavicornis 48
Scelio flavigaster 70, 73, 74, 81, **129–31**, 141
Scelio floridanus 44
Scelio frogatti 104, 141
Scelio fulgidus 6, 8, 12–14, 17–20, 23, 24, 26, 27, 29, 30, 32, 33, 36, 39, 41, 48–50, 62–66, 70, 73, 74, 78, 86, **131–5**, 210
Scelio fulvithorax 70, 73, 74, 78, **135–9**, 83
Scelio gallowayi 70, 73, 74, 81, **139–41**
Scelio gaudens 43
Scelio gobar 12, 14, 17, 19, 25, 26, 33, 37, 42, 48–50, 70, 73, 74, 79, 87, 89, 104, **141–6**, 189, 237
Scelio grbini 70, 73, 74, 80, **146–8**, 234
Scelio hieroglyphi 14–17, 19, 26, 34, 41
Scelio howardi 34, 43
Scelio hyalinipennis 16, 43
Scelio ignobilis 33, 48, 49, 70, 73, 74, 78, 83, 90, **148–50**
Scelio nr. ignobilis 48
Scelio improcerus 17, 30, 33, 48–50, 57, 70, 73, 74, 83, 85, 139, **150–4**, 155, 183, 232, 233
Scelio indicus 43
Scelio javanicus 16, 19, 43
Scelio nr javanicus 21, 27, 29, 37, 43
Scelio jokentae 50, 70, 73, 74, 83, 139, **154–6**
Scelio joni 70, 72–74, 82, **157–8**
Scelio littoralis 56, 70, 72–74, 77, 86, 102, 104, **158–60**, 169
Scelio locustae 17, 33, 48–50, 70, 71, 72, 72–74, 77, 83, 89, 90, 106, 129, **161–3**, 204
Scelio mannesi 57, 85, 89, 117, **163–5**
Scelio mareebaensis 70, 73, 74, 80, 90, **165–7**, 194, 235
Scelio matthewsi 70, 73, 74, 82, 102, **167–9**, 236
Scelio mauritanicus 19, 43
Scelio ?mauritanicus 45
Scelio melanogaster 181
Scelio meridionalis 70, 73, 74, 80, 87, **169–71**
Scelio mikei 53, 56, 59, 61, 70, 73, 74, 79, 85, **171–3**, 189
Scelio muraii 14, 17, 38, 45
Scelio nanocuspis 71, 72–74, 78, 102, 169, **173–5**, 200
Scelio naumanni 71–74, 81, **175–7**
Scelio nigricornis 87, 119, 121, **177–9**
Scelio nigricoxa 76, 89, **179–80**, 210, 221
Scelio nigriscutellum 71, 73, 74, 81, 82, 107, 139, **181–3**
Scelio nigriscutellum pretiosus 181, 183
Scelio nigrobrunneus 71–74, 78, 81, 86, 175, 183–5
Scelio nikolskyi 45
Scelio notabilis 71, 73, 74, 81, 90, **185–7**, 194, 235
Scelio oedipodae 16, 45
Scelio opacus 12–19, 21, 27, 28, 45
Scelio orientalis 18, 48, 71, 73, 74, 77, 85, 102, 104, **187–9**
Scelio ovi 104, 141
Scelio oviphagus 45
Scelio ovivorus 45
Scelio oxyae 24, 45
Scelio pakistanensis 45
Scelio parvicornis 6, 8, 13, 14, 16, 17, 19, 24, 32, 33, 37, 39, 41, 48–50, 71, 73, 74, 81, 87, 189–92, 236
Scelio pambertoni 8, 11, 30, 36, 45, 71, 73, 74, 76, 82, 86, 189
Scelio perplexus 129, 163
Scelio perspicuus 71, 73, 74, 80, 160, **192–5**, 235
Scelio perspicuus littoralis 158
Scelio petilus 59, 61, 71–4, 82, 90, 126, 135, **195–7**, 210
Scelio pigotti 50, 71, 73, 74, 78, 119, 139, **197–8**
Scelio pilosiceps 129, 201, 204
Scelio pilosifrons 53, 71, 73, 74, 78, 115, **198–201**
Scelio pilosus 71–74, 77, 90, 106, 129, 163, 201–4
Scelio planithorax 48, 49, 71, 73, 74, 78, 90, **204–6**
Scelio popovi 19, 45
Scelio ?popovi 45
Scelio princeps 45
Scelio pseudaustralis 71, 73, 74, 79, 189, 205, **206–8**, 237
Scelio pulchellus 108
Scelio pulchripennis 45
Scelio punctaticeps 71, 73, 74, 82, 180, **208–10**
Scelio remaudierei 37, 45
Scelio reticulatum 71, 73, 74, 83, **210–1**
Scelio rufulus 15, 45
Scelio schmelio 71, 73, 74, 81, 194, **212–3**
Scelio semirufus 15, 45
Scelio semisanguineus 71, 73, 74, 79, 89, 178, 211, **214–6**
Scelio semisanguineus nigrocinctus 214
Scelio serdangensis 36, 45
Scelio nr serdangensis 19, 45
Scelio setafascis 54, 57, 71–74, 78, 83, 90, 106, 163, 204, **216–8**
Scelio setiger 71, 73, 74, 76, 79, 189
Scelio stratifacies 71, 73, 74, 82, 123, 180, 189, 192, 210, **219–21**
Scelio striativentris 15, 45
Scelio sudanensis 37, 45
Scelio sulcaticeps 71, 73, 74, 79, 84, 176, **221–3**, 231
Scelio tasmaniensis 71, 73, 74, 79, 85, 223–5
Scelio tristis 19
Scelio ?tristis 45
Scelio tsurukensis 45
Scelio unidentis 71, 73, 74, 76, 90, 115, 200, **225–7**

Scelio uvarovi 13, 14, 17, 37, 40, 45
Scelio varipunctatus 58, 71, 73, 74,
 82, 87, 189, 227–9
Scelio varipunctatus claripes 227
Scelio vulgaris 45
Scelio wallacei 76, 86

Scelio zborowskii 71, 73, 74, 81, 90,
 167, 194, 229–31
Scelio zolotarevskyi 37, 46
Scelio cerdo 47, 68, 70, 72–75, 88, 89,
 102, 169
Scelio cerdo viatrix 18, 46

Sceliorompha 68, 88
Sparasion 68, 88
Synodiella 18, 47, 88, 89
Synodiella bisulca 46
Synodiella bisulcata 18, 25, 36, 46
Trissolcus 57

INDEX TO ORTHOPTERAN GENERA AND SPECIES

Acorypha glaucopsis 43
Acrida 44
Acrida turrita 45
Acrotylus 44, 45
Acrotylus longiceps 45
Acrotylus patruelis 45
Aeropedellus variegatus 46
Ageneotettix deorum 45, 192
Aiolopus patruelis 47
Aiolopus thalassinus 14, 29, 33, 34,
 43–46, 48–50, 135, 150
Aiolopus strepens 34
Atractomorpha a. blanchardi 43, 46,
 49
Aulocara elliotti 4, 16, 192
Austracris guttulosa 33, 48, 50
Austroicetes 146
Austroicetes cruciata 5, 14, 27, 33, 48,
 49, 51, 115, 192
Austroicetes pusilla 48, 49, 51, 115
Austroicetes vulgaris 14, 17, 31, 48–51,
 115, 192
Brachaspis collinus 46
Brachyexarna lobipennis 48, 50, 192
Camnula 8
Camnula pellucida 30, 45
Cataloipus fuscocoeurleipes 43, 44
Catantops axillaris 44, 45
Chondracris rosea 43, 46, 49
Chorthippus 34, 46
Chorthippus albomarginatus 46
Chorthippus apricarius 46
Chortoicetes terminifera 5, 6, 8, 11,
 14, 17–24, 26–28, 30–33, 38, 39, 41,
 48–50, 129, 135, 146, 192
Chortophaga viridifasciata 44, 45, 47
Chrotogonus 44
Chrotogonus senegalensis 44
Chrotogonus trachypterus 43, 44, 46
Cornops aquaticum 47
Crytaceanthracris tatarica 47
Dichromorpha viridis 47
Dissosteira carolina 45
Dociostaurus maroccanus 34

Duronia chloronota 45
Eyprepocnemis plorans 43, 44, 46
Eyprepocnemis rosae 45, 46
Gastrimargus musicus 16, 17, 19, 21,
 25, 26, 33, 48–51, 115, 135, 146,
 206
Gomphocerus sibiricus 46
Hesperotettix viridis 32
Heteracris littoralis 45
Hieroglyphus 26
Hieroglyphus nigrorepletus 34
Hieroglyphus banian 19, 26, 29, 44
Hieroglyphus daganensis 43, 44
Hieroglyphus nigrorepletus 44, 45
Kraussaria angulifera 43, 44
Locusta migratoria 27, 34, 36, 37,
 43–50, 135, 146
L. m. chinensis 34
L. m. manilensis 40
L. m. migratorioides 21, 29, 36, 37,
 40
Macrotona australis 48, 50, 154
Melanoplus 8, 14, 21, 28, 45
Melanoplus bivittatus 12, 27, 34, 45,
 46
Melanoplus confusus 25, 47
Melanoplus differentialis 44, 47
Melanoplus femurrubrum 47
Melanoplus keeleri luridus 47
Melanoplus packardii 45, 46
Melanoplus sanguinipes 17, 27, 37,
 44–47, 192
Melanoplus spretus 45
Mermiria maculipennis 45
Monistria discrepans 34
Morphacris fasciata 44
Neorthacris simulans 47
Nomadacris septemfasciata 34, 44,
 46
Ochridia gracilis 44, 45
Oedaleus abruptus 43
Oedaleus australis 48, 50, 135
Oedaleus senegalensis 34
Oedipoda 45

Orthacris carli 47
Oxya 1
Oxya chinensis 46
Oxya hyla 24, 29, 43, 45, 46
Oxya intricata 29
Oxya japonica 11, 14, 30, 34, 36, 37,
 45, 46
Oxya occidentata 29
Oxya velox 45, 46
Oxya yezoensis 45, 46
Paracinema tricolor 45
Patanga septemfasciata 44, 46
Patanga succincta 44
Phaulacridium vittatum 5, 15, 17, 19
 27, 30, 31, 33, 36–38, 40, 48–50,
 115, 154, 192, 233
Phaulacridium ? vittatum 48
Praxibulus insolens 48, 189
Pyrgomorpha 44
Radinotatus carinatum 47
Schistocerca 44
Schistocerca americana 44
Schistocerca cancellata 11, 30, 34
Schistocerca gregaria 11, 30, 34–36,
 46
Schistocerca obscura 44, 45
Schistocerca piceifrons 44
Scyllinops bruneri 34
Sheriffia haningtoni 44
Shirakiacris shirakii 29, 43, 45, 46
Spathosternum prasiniferum 21, 45, 4
Spharagemon equale 45
Sphingonotus kashmirensis 46
Staudoderus scalaris 47
Stenobothrus 47
Stenobothrus nigromaculatus 47
Stenohippus 43, 45, 46
Triphidid 44
Triphidid annulata 29, 43, 46
Tylotropidius gracilipes 43, 44
Valanga irregularis 17, 30, 33, 48, 4
Valanga nigricornis 44, 163
Zonocerus variegatus 34

INDEX TO OTHER GENERA AND SPECIES

Acridophagus flaviscutellaris (Diptera)
 32
Anastatus (Hymenoptera) 12
Apoanagyrus lopezi (Hymenoptera)
 42
Beauveria bassiana
 (fungal pathogen) 35
Centrodora (Hymenoptera) 12
Centrodora speciosissima
 (Hymenoptera) 24

Ceroplastes sinensis (Hemiptera) 42
Cyrtomorpha flaviscutellaris (Diptera)
 32
Eurytoma (Hymenoptera) 12,
 29
Laius villosus (Coleoptera) 32
Metarhizium flavoviride
 (fungal pathogen) 35
Metarhizium anisopliae
 (fungal pathogen) 35, 40

Nosema locustae (microsporidian)
 19, 40
Phenacoccus manihoti (Hemiptera)
 42
Scirpophaga incertulas (Lepidoptera)
 12
Stomoxys discolor (Diptera) 29
Trichomalopsis parnarae
 (Hymenoptera) 29
Tumidiscapus (Hymenoptera) 12